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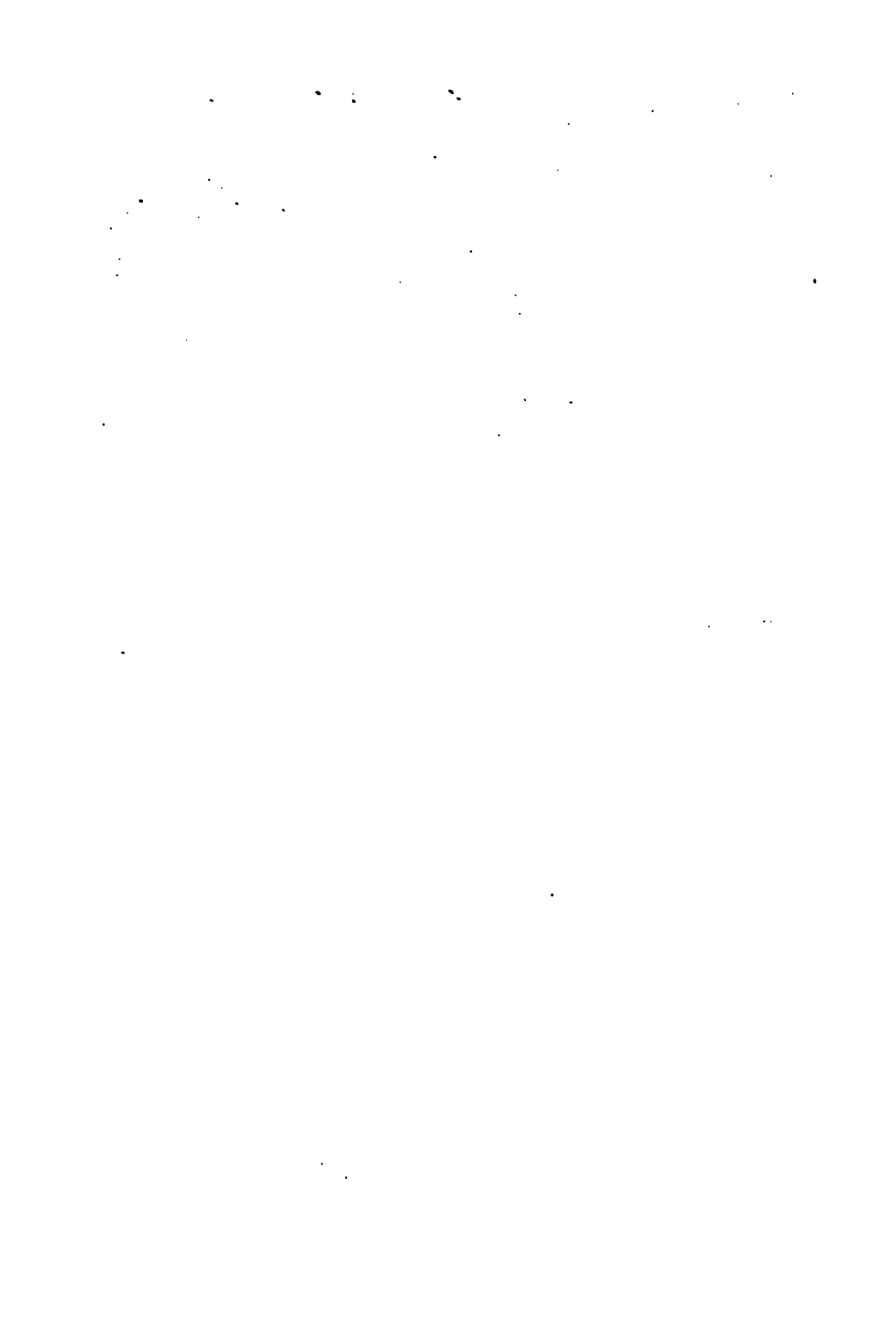
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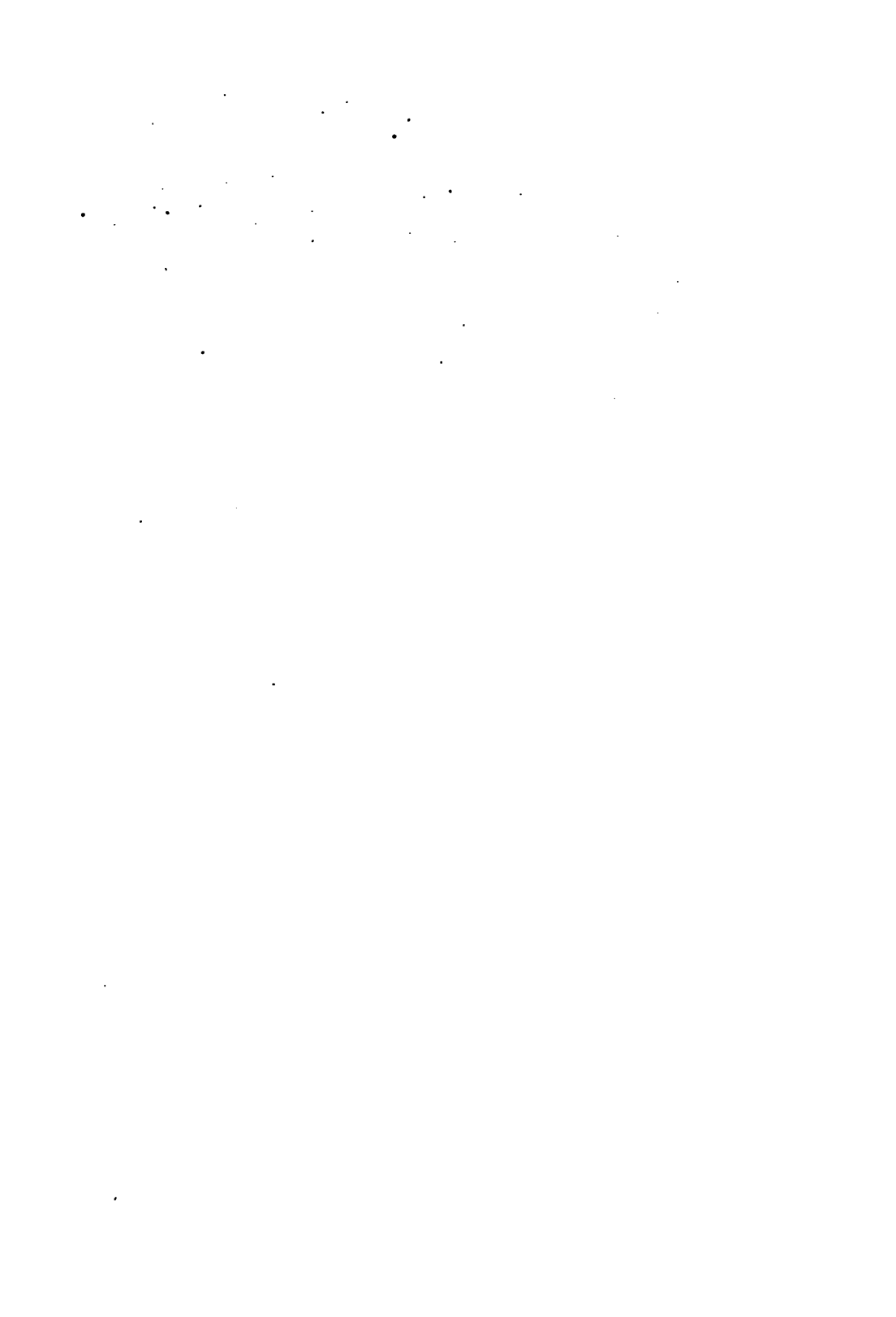
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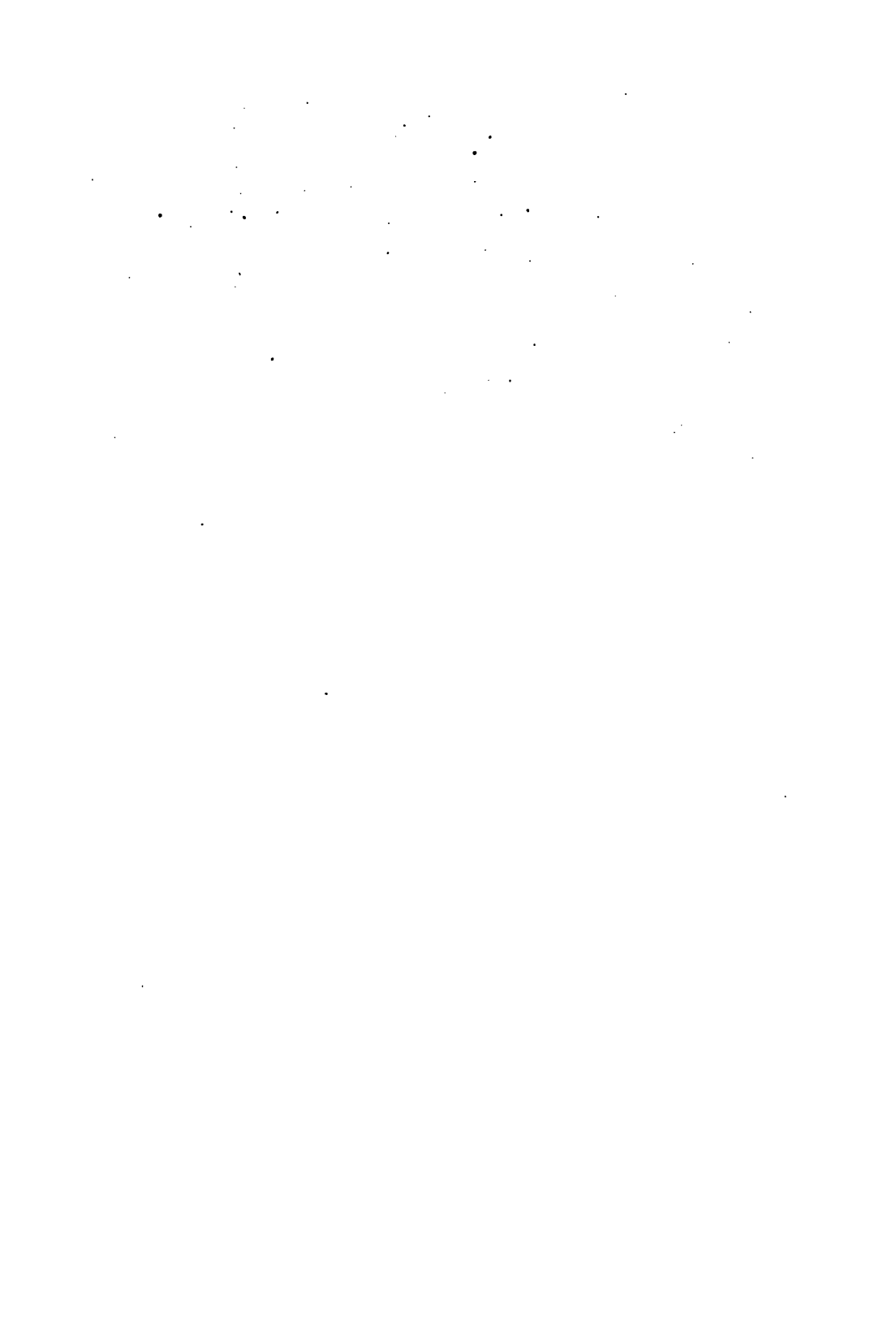


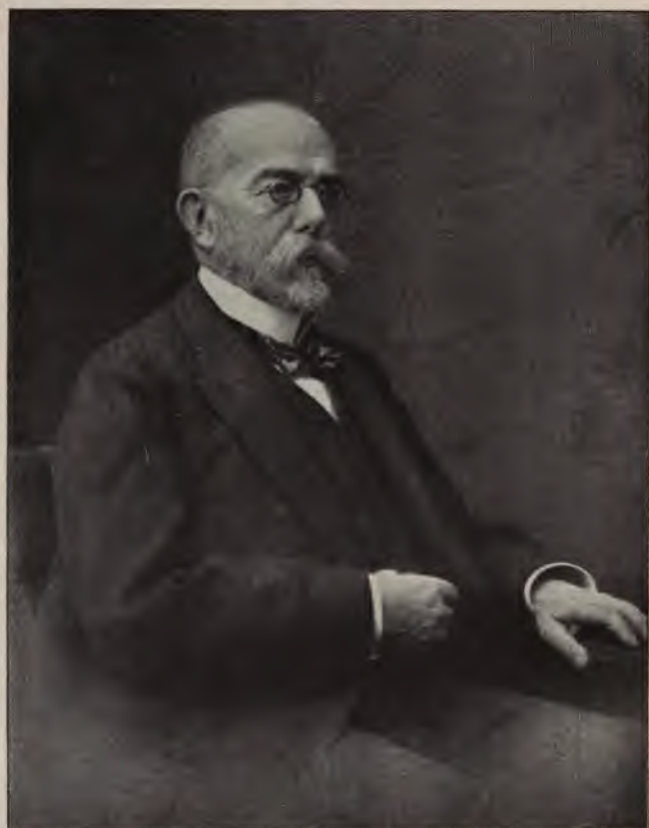
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R. Koch.

PULMONARY TUBERCULOSIS

A HANDBOOK FOR STUDENTS.

BY

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Institute; Consulting Physician to the Boston
Dispensary, Tuberculosis Department, etc.

"This is the malady which the ancients
did call *tuberculosis*, or the wasting disease, and
some do name consumption."

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TO THE LATE
FREDERICK IRVING KNIGHT, A.M., M.D.
A man of profound knowledge and great
experience in Tuberculosis
Teacher, Writer, and Worker in the
Prevention of the Disease

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PREFACE

The author has been engaged in teaching the subject of pulmonary tuberculosis for a considerable number of years, and this manual is largely the result of his experience. It is primarily intended for students of the third and fourth years, to be used in connection with clinical work. It is also hoped that the book may not be without value to physicians who desire briefly to refresh themselves upon this ever-recurring disease. Such a handbook must obviously omit much which properly finds its place in large, exhaustive treatises upon the subject. The object has been to give the main essential facts, emphasizing them in accordance with the author's experience and judgment.

One of the difficulties of the student in making an early diagnosis of pulmonary tuberculosis is his inability to correlate the symptoms and physical signs, and to give to each symptom and sign its due proportionate weight; and in this handbook an attempt has been made to aid him in this respect.

The diagnosis of early clinical pulmonary tuberculosis is easy or difficult much according to the way in which the student sums up his evidence from the examination of the patient and the emphasis he places upon the various symptoms and signs. Noth-

PREFACE

ing, of course, will take the place of much clinical work under expert guidance, but it is hoped that this manual will be of assistance in connection with such work and enable the student to lay a foundation upon which he can firmly build from future experience and study.

The method and arrangement are those which the author has found serviceable in presenting the subject to his classes. Most of what the book contains is the common knowledge of the physician, and only the attempt has been made to so present this knowledge as to give the student a clear conception of the subject as a whole that he may not underrate certain aspects of it and exaggerate others. Many authorities have been consulted, to all of which the author makes his acknowledgments.

E. O. O.

Boston, 1917

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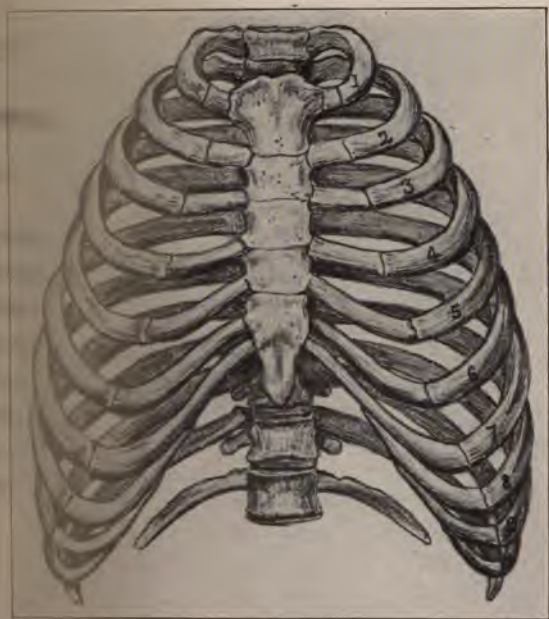


Fig. 1

bræ, and has a backwork convexity. The ribs, somewhat circular in shape, are attached to the spine with varying degrees of obliquity, but all, however, slope downward, outward and forward.

Movement of the Ribs

The ribs are articulated with the vertebræ in such a way that they form a sort of hinge of limited motion so that in the movements of respiration they swing on the fixed spine, up and down, and when elevated in the act of respiration they push the sternum forward and thus increase the antero-posterior diameter of the chest, and at the same time the intercostal spaces are widened. Another motion also takes place when the ribs rise: they describe a rotary motion outward around an imaginary axis which unites with the two ends of the ribs, and thus the transverse diameter of the chest is increased.

Intercostal Spaces

The intercostal spaces differ in size, being larger between the upper ribs than the lower. The second, third, tenth and eleventh interspaces are the widest, and the widest part of each individual space is near the anterior part of the ribs. These spaces are closed by the intercostal muscles. Lying in a sort of gutter under the rib, at its lower border, are the intercostal artery, vein and nerve; in aspirating the chest, consequently, the arm on the affected side should be brought forward with the hand

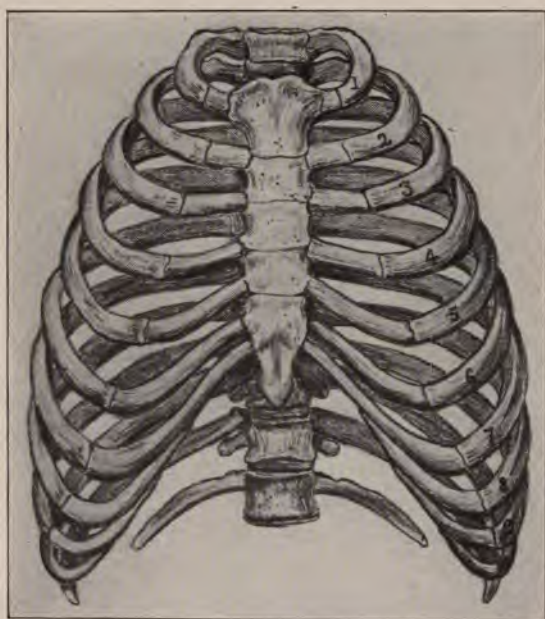


Fig. 1

placed on the opposite shoulder so as to widen the interspace, and the aspirator needle thrust in at right angles close to the upper margin of the rib so as to avoid wounding these vessels.

Counting the Ribs

It is often necessary to count the ribs and it is sometimes difficult to do so directly, so that it is helpful to have some landmarks. The following are given by Holden:

(a) "The angle of Ludovici, formed by the manubrium and gladiolus, is at the second rib."

(b) "The nipple of the male is placed, in the great majority of cases, between the fourth and fifth rib."

(c) "The lower external border of the pectoralis major corresponds with the direction of the fifth rib."

(d) "A line drawn horizontally from the nipple round the chest cuts the sixth intercostal space midway between the sternum and the spine." (This is a useful guide in tapping the chest.)

(e) "When the arm is raised the highest visible digitation of the serratus magnus corresponds with the sixth rib, the digitations below this correspond respectively with the seventh and eighth ribs."

(f) "The scapula lies on the ribs from the second to the seventh inclusive."

(g) "The eleventh and twelfth ribs can be felt even in corpulent persons outside the erector spinæ, sloping downward."

(h) "One should remember the fact that the sternal end of each rib lies on a lower plane than its corresponding vertebra"; for instance, a line drawn horizontally backward from the middle of the third costal cartilage, at its junction with the sternum, to the spine, would touch the body not of the third dorsal vertebra but of the sixth. Again, the end of the sternum would be on about the level of the tenth dorsal vertebra. Much latitude must be allowed here for variation in the length of the sternum, especially in women."

Diaphragm

The base of the thoracic cavity is closed by the diaphragm, a dome-shaped muscle attached to the ensiform cartilage in front, to the cartilages and bony portions of the sixth and seventh inferior ribs on each side, and behind to two aponeurotic arches and to the lumbar vertebræ.

The diaphragm acts actively in conjunction with the intercostal muscles in inspiration, while in expiration it becomes passive and is pushed up by the action of the abdominal muscles. By the contraction of the diaphragm in inspiration the chest is enlarged in its vertical direction. When the chest has become very rigid, or when the intercostal muscles are paralyzed, the diaphragm becomes the chief or only muscle of respiration. Also in ordinary tranquil breathing of the sedentary person this muscle does most of the work of respiration (abdominal respiration), as can be readily observed

in watching the chest of a person at rest. Interference with the free movement of the diaphragm by a distended stomach or fluid in the peritoneum causes dyspnœa. No other muscle in the body, except the heart muscle, works so unceasingly as the diaphragm. Day and night, from birth to death, with only periods of rest of seconds, this faithful muscle does its duty. It is a very powerful muscle, and Campbell speaks of a man whom he knew who could move a grand piano by means of it. In forced inspiration the diaphragm is displaced downward three and one-half inches, which can be determined by the extension of resonance on percussion. The fluoroscope and the "Litten's phenomenon" indicate visibly the movements of the diaphragm. In early pulmonary tuberculosis the excursion of the diaphragm is diminished on the affected side, as can be demonstrated by the fluoroscope. I do not, however, consider this a very important diagnostic sign.

The Thoracic Cavity and Pleuræ

The top of the thoracic cavity is shut in by the muscles about the neck. The interior of the cavity is lined by the pleuræ, a serous membrane whose chief function is to enable the lungs to expand equally in all directions.

When pleural adhesions occur from inflammation of the pleuræ, this free movement of the lungs is impeded, and this may be one reason why the apices of the lungs are so prone to tubercular in-

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fection; hence, as Campbell points out, "those with pleuritic adhesions should frequently resort to costal breathing." When the pleuræ are normal, they are smooth and frictionless, and their inner surface is constantly lubricated with the serous fluid, so that the two layers slide freely upon each other and the movement of the lungs in respiration causes no sensation; if, however, the pleuræ become roughened by inflammation, one experiences a "pleuritic pain" on breathing, and hence the reason for strapping the chest over the affected side to restrict the respiratory movement and thus lessen the pain.

There is a right and left pleura separated by a space called the mediastinum which contains the heart and great vessels. Each pleura is two-fold, an outer parietal layer which is thick and feebly adherent to the inner wall of the chest throughout its entire extent and is reflected upon the superior surface of the diaphragm below, and above it extends through the upper opening of the thorax into the neck; and an inner or visceral layer which is extremely delicate and very transparent. It is very adherent to the lungs and invests them completely, dipping to the bottom of the fissures which divide the lungs into lobes.

Cavity of the Pleura

The interspace between the two layers of the pleura is called the cavity of the pleura, which normally is closed, the parietal and visceral layers being in apposition. When, however, an effusion occurs

the two layers are separated by the fluid, and when also the operation of artificial pneumothorax is performed the gas likewise separates the two layers, compressing the lung. The pleural cavity shows a negative pressure, and when opened the positive pressure of the outside air instantly collapses the lung. When the opening to the outside air, however, is closed, the air inside is slowly absorbed and the lung expands again. When from disease an opening from the lungs into the pleural cavity occurs, the lung is likewise collapsed and a pneumothorax is formed, the pressure from the inside being the same as that of the outer air. The parietal or costal layer of the pleura is attached to the chest wall by connective tissue and when from an injury or puncture, as in artificial pneumothorax, air enters into the space between the chest wall and costal pleura, a deep emphysema is developed.

When the cavity of the pleura requires tapping to evacuate fluid the sixth or seventh intercostal space midway between the sternum and spine is usually selected.

The right and left pleural cavities are separate and distinct; and the parietal pleura, at the point of its reflection upon the upper part of the diaphragm is called the inferior cul-de-sac of the pleura; hence, we can have diaphragmatic pleurisy.

Lymphatics of the Pleuræ

The lymphatics of the pleura are abundant, both in the parietal and visceral layers, those of the latter

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connecting with the lymphatics of the lungs, and those of the former with the lymphatics of the thoracic wall. It is through this lymphatic system in conjunction with the respiratory movements that the pleuritic fluid is chiefly absorbed.

The Lungs

The lungs fit into the pleura-lined chest, the rounded apex projecting about one and one-half inches above the sternal end of the clavicle and the concave base fitting accurately upon the convex top of the diaphragm. The lower limit of the lungs can be represented by a line drawn around the chest from the junction of the sixth costal cartilage with the sternum to the spinous processes of the tenth dorsal vertebræ. The right lung (Fig. 2) is shorter and broader than the left and has three lobes and two fissures. The left lung (Fig. 3) has two lobes and one fissure. The lungs occupy four-fifths of the thoracic cavity, the remaining space being occupied by the heart and hilus of the lungs, formed by the bronchi, the pulmonary artery and vein, the lymphatic vessels, nerves and glands.

The normal weight of the lungs varies between 1100 and 1200 grams (5 or 6 lbs.) in the male, and 900 to 1100 grams (4.1 to 5 lbs.) in the female.

The substance of the lungs is of a spongy texture, consisting of a mass of minute cavities — the alveoli — which are encircled by a mesh of capillary vessels only separated from the air by the exceedingly thin membrane of the alveoli. By this



Fig. 2. The Right Lung



Fig. 3. The Left Lung

mechanism the oxygen entering the lungs is absorbed by the blood and carbon dioxide, nitrogen and watery vapor excreted. Elastic tissue enters largely into the composition of the lungs and upon this elastic tissue their expansibility depends. When the chest is opened the lungs collapse to about a third of their ordinary size. In emphysema of the lungs this elasticity is to a great extent lost and, in consequence, they are in a constant state of distension.

The general shape of the lungs is triangular, or conical, and is conformed to the shape of the thoracic cavity. In front the anterior edges of the lungs do not come together in tranquil breathing, while in forced inspiration they meet over the base of the heart. The anterior edge of the right lung is nearly vertical, while that of the left is oval or oblique.

Boundaries of the Lungs and Lobes

Above, the lungs extend about one and one-half inches beyond the sternal end of the clavicle; below, from the sixth costal cartilage of the sternum to the spinal processes of the tenth dorsal vertebræ. The following table will be useful in fixing in one's mind the boundaries of the lobes:

Right Lung; Three Lobes

	<i>Anteriorly</i>	<i>Laterally</i>	<i>Posteriorly</i>
Upper Lobe	Apex to Fourth Rib	To Fourth Rib	Apex to Spine of Scapula

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	<i>Anteriorly</i>	<i>Laterally</i>	<i>Posteriorly</i>
Middle Lobe	Fourth Rib to Inferior Angle of Sixth Rib	Fourth to Sixth Rib	Nil.
Lower Lobe	Nil.	Sixth to Eighth Rib	Spine of Scapula to Tenth Rib

Left Lung; Two Lobes

Upper Lobe	Apex to Sixth Rib	To Fourth Rib	Apex to Spine of Scapula
Lower Lobe	Nil.	Fourth Rib to Base	Spine of Scapula to Tenth Rib

One can easily remember that in front on the right side we have the upper and middle lobe (Fig. 4), and on the left the upper lobe (Fig. 5), while behind we have an upper and lower lobe on each side. It is helpful to remember the boundaries of the lobes of the lungs, and particularly to bear in mind how large a part of the organ, posteriorly, consists of the lower lobe. It is of aid in determining the extent of a pneumonic consolidation; whether or not a tuberculous process has invaded the lower lobe; and in making a diagnosis between solidification of the lower lobe and an effusion.

Lymphatics of the Lungs

The lymphatics of the lungs, which are abundant, are superficial and deep and terminate at the root of the lungs in the bronchial glands, which lie along the lower portion of the bronchi and trachea.



Fig. 4. Longitudinal section through the right mammary line
From Garré und Quineke, Lungenchirurgie



Fig. 5. Longitudinal section through the left mammary line
From Garrè und Quincke, Lungenchirurgie

These glands readily enlarge in various infectious diseases, particularly in tuberculosis. Such enlarged glands can be detected by the X-ray and also sometimes can be made out with more or less definiteness by percussion and auscultation. When much enlarged they give rise to cough and dyspnoea (Fig. 6). (Fig. 6a.)

The Bronchi and Trachea

The lungs are connected with the outer air by means of the bronchi and trachea. The latter starts opposite the lower border of the sixth cervical vertebra and ends between the fourth and fifth thoracic vertebræ. It is four to four and one-half inches long, and bifurcated into the bronchi just above the level of the junction of the manubrium sterni and gladiolus. The right bronchus follows more nearly than the left the course of the trachea. From the two main stems are given off lateral branches and these divide and subdivide until at last they terminate in the lobules and these again in the intercellular passages and air cells.

The bronchi are accompanied by branches of the pulmonary artery, the lymphatics and nerves. The arch of the aorta is in close relation with the left bronchus and in aortic aneurysm we may have partial or complete obstruction of the bronchus, and as a result the development of acute bronchiectasis.

Landmarks of the Lungs (Holden)

1. "The apex of each lung rises into the neck behind the sternal end of the clavicle and the sternomastoid muscle about one and one-half inches."

2. "There is little or no lung behind the first bone of the sternum."

3. "From the level of the second costal cartilage to the line of the fourth the margins of the lungs run parallel, or nearly so, close behind the middle of the sternum."

4. "Below the level of the fourth costal cartilage the margins of the lungs diverge, that of the right corresponds with the direction of the cartilage of the sixth rib, while that of the left being notched for the heart, runs behind the cartilage of the fourth rib. A line drawn perpendicularly from the nipple would find the lung margin about the lowest part of the sixth rib."

5. "In deep inspiration the lung margins descend about one and one-half inches."

The Shape of the Chest and Its Modification by Disease

In the normal chest the antero-posterior diameter is about one-fourth less than the transverse diameter. The horizontal section of the chest shows the general form of an ellipse. The adult female chest is generally more barrel-shaped than the male chest. As abnormal modifications, we have:

(a) The emphysematous chest which is more or less barrel-shaped.

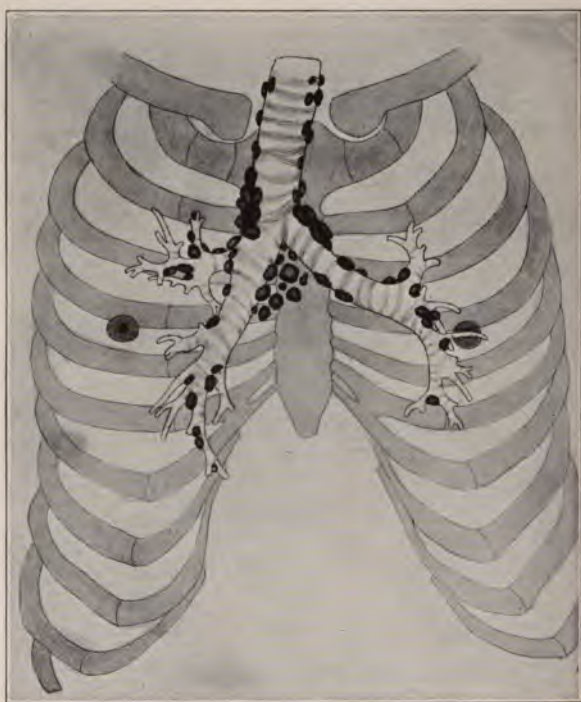


Fig. 6. The relationship of the bronchial glands to the anterior thoracic walls

From Stoll—"American Journal of Diseases of Children"—1912—
vol. 4. 333-359

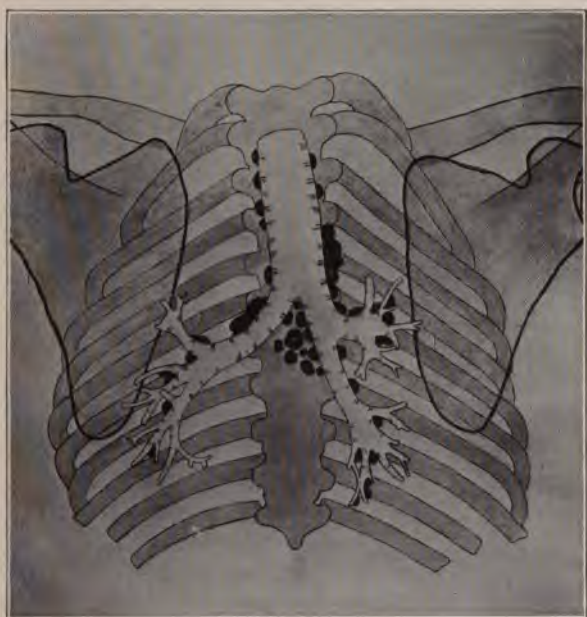


Fig. 6a. The relationship of the bronchial glands to the posterior thoracic walls

From Stoll—"American Journal of Diseases of Children"—1912—
vol. 4. 333-359

(b) The flat chest, the so-called "phthisical chest," although a flat chest does not necessarily indicate a tendency to tuberculosis.

(c) The "pigeon-breasted," also called the "keel chest" which is characterized by its triangular shape: the sternum is pushed forward, increasing the antero-posterior diameter. This deformity is caused by a long existing impediment to free inspiration, such as enlarged tonsils, adenoids, or by chronic bronchitis or whooping cough.

(d) The rachitic chest where there is a lateral compression of the chest walls and a relative increase in the antero-posterior diameter.

(e) The funnel, gutter or cobbler's chest, characterized by a depression of the lower part of the sternum. This formation may be the result of rickets, or it may be congenital or acquired, as in the case of the cobbler.

(f) The "Alar-chest," in which the angles of the scapulæ project which gives them a wing-like appearance. Such a chest is generally of small capacity and is supposed to suggest a predisposition to tuberculosis.

We have also unilateral changes in the chest: one side may be increased in size over the other, as from pleural effusions, pneumothorax, or compensatory hypertrophy; or one side may be retracted, as from tubercular contractions, the result of long compression of the lung by pleural effusion, or of an empyema.

Again, we may have local changes in the shape

of the chest, such as bulging in the lower anterior or lateral region, as in the case of empyema where the pus tends to be evacuated; or a contraction above and below the clavicle, which is frequently observed in tuberculosis. Other causes are atelectasis, bronchiectasis, and pleural adhesions.

Physiology of Respiration

Respiration consists of two separate acts, inspiration, which is essentially active, and expiration, which is almost entirely passive. The muscles engaged in ordinary inspiration are the intercostals, the diaphragm, the levatores costorum, scaleni and serrati postici. The movements of expiration are chiefly due to the elasticity of the lungs and the passive return of the diaphragm and chest walls. In ordinary quiet breathing there is comparatively little rib movement, especially in the upper half of the thorax, inspiration being almost entirely abdominal. This is less so with women. In extraordinary inspiration many other muscles come into play,—indeed, all the muscles about the chest, which by fixing their point of attachment can aid in elevating the ribs and expanding the chest, such as the pectorals, latissimus dorsi, quadrati lumborum, sterno-mastoid, erector spinæ and infrahyoid. In a severe attack of asthma, for example, many of these muscles can be seen at work in a frantic attempt to get more air into the lungs. Any impediment to the free movements of the chest or action of the muscles of respiration obviously inter-

fere with free adequate respiration. Such impediments may be pathological or mechanical. Of the former we may have diseases of the lungs, pleural effusions, aneurysm of the aorta, curvature changes in the thoracic walls, ascites, peritonitis, abdominal tumors, etc. Of the latter — mechanical — are posture, flatulent distension of the stomach, constriction, like tight corsets.

The general movement of the chest is also greatly diminished in emphysema, in certain cases of asthma, and from injuries to or diseases of the spinal cord which paralyze the muscles of respiration. The movements of one side of the chest may also be diminished, as in pleural effusion, pneumothorax, pneumonia and tuberculosis.

Increased expansion occurs during violent exercise; in the early stages of febrile diseases; from various emotional disturbances, and sometimes in dyspnoea. When in the case of an unilateral tuberculosis increased expansion of the other lung occurs, it is a favorable prognostic omen. There is a retraction or general drawing in of the intercostal spaces when there is any obstruction to the entrance of air, as in croup, the pressure of an enlarged thyroid gland, an aneurysm, or a tumor pressing on the trachea or bronchi. This also sometimes happens in bronchial asthma.

The relation of the act of inspiration to that of expiration is as 5 to 6; but the relative duration of the sounds, however, are as 3 to 1, while the expiratory sound is often quite inaudible.

The circumference of the normal chest averages 34 inches, or 87 c.m., and the expansion on forced inspiration from one and one-half to five inches, or 4 to 13 c.m. Much depends upon practice in deep breathing.

Vital Capacity of the Lungs

The vital capacity of the lungs, or the amount of air exhaled on a forced expiration, after a forced inspiration, is about 230 or 240 cubic inches, or 3600 c.c. in men and 150 cubic inches, or 2500 c.c. in women. In one thousand observations which I made upon males from sixteen to forty years of age, I found the average to be 240 cubic inches. The vital capacity is measured either by the water or dry spirometer. The vital capacity is generally diminished in all diseases of the respiratory organs, and hence this measurement is of some value in judging of improvement in a case of tuberculosis, for example.

The "tidal air," the amount of air inhaled and exhaled in quiet breathing, is about 500 c.c. or 30 cubic inches. The "complemental air," the additional amount one can take in by forced inspiration, is from 1500 to 2000 c.c. or 90 to 120 cubic inches; and the "supplemental air," the additional amount one can exhale in excess of the normal tide, by forced expiration, is from 1200 to 1500 c.c. or 72 to 90 cubic inches. The "residual air," what is left in the lungs at the end of forced expiration,

is estimated at from 1200 to 1500 c.c. or 72 to 90 cubic inches.

The following measurements which the writer made and collected will serve as fairly accurate standards of chest measurements and lung capacity. The "muscular" circumference of the chest was taken at the level of the nipples and the "respiratory" circumference two inches below:

Measurements of the Chest and Lung Capacity

TABLE I

CHEST MEASUREMENTS

GIRTH OF CHEST.	MUSCULAR	<i>Repose</i> <i>inches</i>	<i>Inflated</i> <i>inches</i>	<i>Difference</i> <i>inches</i>
<i>Men</i>				
Average of Dr. E. O. Otis, one thousand measurements, between sixteen and forty years of age		34.0	36.1	2.1
Average of Dr. Hitchcock, of Amherst College. Eight thousand measurements ..		34.6	36.5	1.9
Average of E. Hitchcock, Jr., of Cornell College. Fif- teen thousand measure- ments		34.5	36.3	1.8
<i>Women</i>				
Mt. Holyoke and Wellesley students. Measurements of Miss Wood and Dr. Mary Colton		29.5	31.5	2.0
RESPIRATORY CHEST				
<i>Men</i>				
Average of Dr. E. O. Otis. One thousand measurements		31.1	33.1	2.0
<i>Women</i>				
Fifty per cent. of fifteen hun- dred Wellesley students. Miss Wood		24.6	27.2	2.6

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MEASUREMENTS OF THE CHEST AND LUNG CAPACITY

Continued.

DEPTH OF CHEST	<i>Repose</i> <i>inches</i>	<i>Inflated</i> <i>inches</i>	<i>Difference</i> <i>inches</i>
<i>Men</i>			
Average of Dr. E. O. Otis. One thousand measurements in repose and one hundred and twelve measurements inflated	7.3	8.2	0.9
<i>Women</i>			
Fifty per cent. of fifteen hun- dred students at Wellesley. Miss Wood	6.9		
BREADTH OF CHEST			
<i>Men</i>			
Average of Dr. E. O. Otis. One hundred and fifty meas- urements	9.6	10.8	1.2

TABLE II
CAPACITY OF LUNGS

	<i>Cubic</i> <i>Inches</i>
<i>Men</i>	
Average of Dr. E. O. Otis. One thousand measure- ments	240.6
Hitchcock. Eight thousand measurements	230.0
Hitchcock, Jr. Fifteen thousand measurements	236.6
<i>Women</i>	
Mt. Holyoke and Wellesley students. Measurements of Miss Wood and Dr. Mary Colton	145.8
Fifty per cent. of fifteen hundred Wellesley students. Miss Wood	150.3

TABLE III
COMPARISON OF THE "VITAL" OR LUNG CAPACITY AND THE
AMOUNT OF AIR EXPELLED AFTER AN ORDINARY QUIET IN-
SPIRATION. AVERAGE OF DR. E. O. OTIS. ONE HUN-
DRED AND FIFTY MEASUREMENTS

	<i>Cubic</i> <i>Inches</i>
Vital capacity, or the amount of air exhaled after a full inspiration	230.5

Amount of air exhaled after an ordinary quiet inspiration	129.3
Difference, or "complemental" or "reserve" air	101.2

Average Lung Capacity for Height

<i>Height.</i>	<i>Lung Capacity</i>	<i>Average for each inch or Centimeter in Height.</i>
66 to 67 inches, incl.	231.62 c. in.	3.4 c. in.
167.7 to 170.3 cms.	3,797 c. cms.	22.4 c. cms.
67 to 68 inches, incl.	237.10 c. in.	3.46 c. in.
170.3 to 172.8 cms.	3,903 c. cms.	22.7 c. cms.
68 to 69 inches, incl.	244.44 c. in.	3.5 c. in.
172.8 to 175.4 cms.	4,007 c. cms.	23.06 c. cms.
69 to 70 inches, incl.	259.34 c. in.	3.64 c. in.
175.4 to 177.9 cms.	4,250 c. cms.	24.06 c. cms.
70 to 71 inches, incl.	261.38 c. in.	3.64 c. in.
177.9 to 180.5 cms.	4,284 c. cms.	23.9 c. cms.
71 to 72 inches, incl.	261.34 c. in.	3.5 c. in.
180.5 to 183 cms.	4,284 c. cms.	23.03 c. cms.
General average		3.52 cubic inches.
		23.19 cubic cms.

As has been said, the expiratory act, although essentially passive as regards the muscles of respiration, takes place by a shrinkage of the lung tissue by means of its elasticity. When this elasticity is impaired by degenerative changes or disease, expiration is incomplete or difficult. Normal respiration occurs at the rate of about 16 times per minute. We may say anything between twelve and twenty is normal. The ratio of the respiration to the pulse rate is about one to four or five.

Abnormalities of Respiration

(a) *Dyspnœa* — difficult, rapid, labored respiration — occurs in a variety of conditions, such as heart disease, pneumonia, extensive pleural ef-

fusion, asthma, tuberculosis, anæmia, and acute infections. We have both expiratory and inspiratory dyspnœa. When both exist, which is commonly the case, it is called mixed dyspnœa. Functional dyspnœa occurs as a result of violent exercise or emotional disturbances.

(b) Orthophœa: excessive dyspnœa, when the patient is obliged to sit up in order to breathe more easily.

(c) Obstructive dyspnœa, from some hindrance to free entrance of the air into the lungs, caused by various obstructions in the pharynx, larynx, trachea or bronchi, such as enlarged tonsils, peritonsillar abscess, œdema glottis, foreign bodies in the upper respiratory tract, stenosis of the larynx or trachea, aneurysm, tumors, etc.

(d) Apnœa: a temporary cessation of breathing, illustrated in so-called "Cheyne-Stokes" respiration, which is characterized by a waning and waxing of the respiration. Beginning with a number of superficial respirations, they gradually deepen until full respiration or even dyspnœa is reached; then the respirations decline in force and length until a state of apnœa occurs which may last so long that one may believe that the patient is dead.

(e) Asphyxia: a sudden arrest of respiration from outward violence, as in choking, or in apparent drowning. In many instances of apparent death from asphyxia, resuscitation may be effected by means of artificial respiration at once applied and continued for a long time.

Other abnormalities of respiration are indicated by the names given them, as stertorous, stridulous, asthmatic, shallow, jerky, sighing, catchy, restricted.

A study of the respiration, both in health and disease, is of much value and conveys much useful information. Breathing exercises are an important preventive measure as well as a valuable aid in some of the abnormal conditions of the lungs. Proper full respiration is, in modern life, more or less of an acquired habit, and it is of importance that the physician himself should first learn to breathe correctly and then he will be able to teach his patients to do the same. There are a few easily acquired breathing exercises, both simple and efficient, which will develop the chest and increase the lung capacity, and which will be of value in preventing disease, as well as helpful in the treatment of various diseases. For an exhaustive study of this subject, one is referred to the treatise upon "Respiratory Exercises in the Treatment of Disease" by Harry Campbell, M. D. N. Y. Wm. Wood & Co.

CHAPTER II

THE HISTORY OF TUBERCULOSIS

"Other men labored, and ye are entered into their labors."
John, iv, 38.

The world-wide prevalence of tuberculosis, its predominant influence in medicine, and its antiquity warrant some brief mention of its history, that we may learn through what labor and sacrifice our present knowledge of the disease has come down to us. When and how did tuberculosis have its origin? No one knows; all we know is that "phthisis" or "consumption," as it was called, has existed almost as long as recorded events. As some one has expressed it, "it has always existed."

That celebrated physician of antiquity Hippocrates, who was born about the time of Socrates (460-377 B. C.), the supposed period of the Jewish return from their exile at Babylon, gives the first clear clinical description of the disease. He considered it to consist of a suppuration of the lungs, which might be of an acute or chronic nature; that it resulted from mucus, blood or other morbid products in the lungs or pleural cavity, which failing to be absorbed was changed into purulent matter. He thus describes the course of "phthisis":

"With many persons," he says, "it commenced during the winter, and of these some were confined to bed, and others bore up on foot; the most of these died early in the spring who were confined to bed; of the others the cough left not a single person, . . . in the greater number of cases the disease was long protracted." In his aphorisms he says: "Phthisis most commonly occurs between the ages of 18 and 35."

"In persons who cough frothy blood, the discharge of it comes from the lungs."

"Diarrhœa attacking a person afflicted with phthisis is a mortal symptom." (*Adams' translation.*)

Hippocrates recommended tar as a remedy, suggestive of the modern creosote treatment.

Isocrates, a contemporary of Hippocrates, considered pulmonary phthisis to be a contagious disease,—a keen observer.

In the first century of the Christian era (50 A. D.) Aretæus Cappadox, a celebrated Greek physician, wrote very intelligently of the disease and was the first to clearly describe pulmonary tuberculosis, or phthisis, as it was then called, as a definite pathological process. He considered it to be caused by abscess of the lungs, chronic bronchitis or pulmonary hemorrhage from which pus might be formed in the lungs. For treatment he recommended sea voyages and the use of milk and eggs. Celsus, a Roman contemporary of Aretæus, held that there were three forms of consumption: (a)

an atrophy of the lungs; (b) cachexia; (c) ulceration of the lungs. He advised the use of mutton suet boiled in flour.

Galen (130 A. D.), the most eminent physician after Hippocrates, held views as to the pathology of the disease similar to those of his great predecessor. He considered it to be an ulceration or suppuration of the lungs; the destroyed portions being discharged in the expectoration. This condition he compared with ulceration of other organs, as of the stomach, bladder, etc. In his opinion the disease was due to irritation or injury of the lung tissue followed by hemorrhage, although he recognized that ulceration of the lung might occur without hemorrhage, caused by corrupt secretions. When the disease occurred in this way, he considered it incurable. He also mentions its infectious nature. He recommended the same treatment as had been found successful in treating ulcers in other organs, namely, such measures as would dry up secretions; hence, he used to send his consumptive patients to dry, elevated resorts. He also advised a milk diet.

After Galen, a long period elapsed before any advance was made in the knowledge of phthisis. Indeed, it was not until the middle of the seventeenth century, when practical anatomy began to be studied—the “Anatomical Period”—that there was any notable advance in the knowledge of the disease.

Sylvius (1614-1672) was the first to accurately

describe tubercles of the lungs. In his "Tractus de Phthise" he attributes the ulceration of the lungs to the suppuration of tubercles which in softening finally produced cavities. He believed that there were two varieties of pulmonary phthisis: the one due to purulent infiltration of the lungs (the Hippocratic and Galenic theory) caused by hemoptysis, or empyema, and characterized by ulceration, supuration and destruction of lung substance; and that the other variety was the result of a scrofulous constitution due to enlarged lymph glands or nodes in the lungs which suppurated, softened and were converted into tubercles.

Richard Morton (1689), an English physician, was the most important investigator after Sylvius, and in his celebrated work on "Phthisiology" he emphasizes the tubercle as the true cause of the disease and that phthisis was always dependent upon it. Like Sylvius he also noted the relation between phthisis and scrofula. Morton was the first who maintained that the tubercle was a necessary antecedent to ulceration. Morton recognized the great prevalence of consumption, and in the following quotation he seems to have truly divined what we all now believe, that almost every adult has some tuberculous infection. He says: "Yes, when I consider with myself how often in one year there is cause enough ministered for producing these swellings, even to those that are wont to observe the strictest rules of living, I cannot sufficiently admire that any one, at least after he comes

to the flower of his youth, can dye without a touch of consumption."

As time went on, many other eminent investigators, as Sydenham (1624-1669), Boorhaave (1668-1738), Swieten (1700-1732), Morgagni (1682-1771), Auenbrugger (1722-1809) (the discoverer of percussion) wrote upon phthisis but giving essentially the same views as their predecessors.

The next most important advance in the pathology of phthisis was made by Matthew Baillie in 1793, who, in a small treatise entitled "The Morbid Anatomy of the Most Important Parts of the Human Body," describes as the most frequent lesion in the diseased lung the presence of small nodes, at first about the size of the head of a pin, which later coalesce and increase in size. These nodes breaking down and suppurating he regarded as the cause of consumption. Baillie appeared to make a distinction between scrofulous glands and the nodes or tubercles, although he held that they both possessed the common property of being changed into caseous matter.

Bayle (1774-1816) may be considered the founder of the modern pathology of pulmonary tuberculosis. He started with the miliary tubercle and described its development from the solid condition to the stage of caseation and softening. Since tubercles occurred in other organs of the body, he concluded that phthisis was not a disease confined to the lungs alone. He considered it a general disease of a specific nature, and not a local

one, caused by inflammation of the glands or lymphatic system. He believed that hemoptysis was a result and not a cause of tuberculosis. He made six types or forms of phthisis, namely:

- (a) Tuberculous phthisis.
- (b) Granular phthisis.
- (c) Phthisis with melanosis.
- (d) Ulcerative phthisis.
- (e) Calculous phthisis.
- (f) Cancerous phthisis.

Laennec (1781), the inventor of the stethoscope and the discoverer of mediate auscultation, maintained that there was but one species of phthisis, namely, the tuberculous, and he considered phthisis and tuberculosis of the lungs as identical, both having their origin in the miliary tubercle. This was called the "Unity Theory." Louis (1827), the great French physician and successor of Laennec, also agreed with his predecessor and adopted his views.

With Laennec and his school the period of open-eyed observation closed and that of histological investigation followed.

Virchow (1850), an eminent German pathologist and the founder of the so-called "cellular pathology," was the father of the "dualistic theory," which was that there were two kinds of phthisis:—

- (a) Tuberculous phthisis.
- (b) Caseous pneumonia.

Virchow also held that caseation was a general

pathological change met with in many morbid products and not peculiar to tubercle.

Niemeyer (1866), a distinguished follower of Virchow, strenuously sustained his master's theory, and thought that the worst fate that could befall a consumptive was to become tuberculous. For many years Niemeyer's text book upon general medicine was the standard one in the medical schools, and so the dualistic theory was generally taught and accepted.

We come now, finally, to the period of experimental investigation.

Klencke (1843) produced tuberculosis in rabbits by injecting into their jugular veins tubercle cells taken from miliary tubercles and from tubercles in the stage of gray infiltration. It is doubtful if he himself fully appreciated the importance of his discovery. However it may be, his work was forgotten and had no influence upon the existing theory of tuberculosis.

Villemin (1865), a French army surgeon, repeated on a far more extensive scale, the experiments of Klencke. He inoculated rabbits with matter and sputum from tuberculous individuals and also from the tuberculous tissue of a cow. In every case he produced tubercles in the lungs. When he injected animals with pus, however, no tuberculosis resulted. Villemin's paper presenting his experiments and their results, published in 1865, may be classed with Koch's later contribution upon the discovery of the tubercle bacillus, as great

epochal contributions to scientific medicine. Villemin, however, did not escape the lot which befalls most discoverers of new things in medicine. His conclusions were so novel and so at variance with the accepted ideas of the time that they did not receive universal acceptance. Furthermore, some authorities thought that his experiments were faulty and hence his conclusions were to be doubted.

Conheim, however, in 1877 repeated and amplified Villemin's experiments. He injected tuberculous matter into the anterior chamber of the eye of a rabbit and thus by ocular proof demonstrated the fact of the inoculability of tuberculosis, for he saw the gradual development of the specific tubercle.

Other investigators corroborated these experiments of Villemin and Conheim. Thus, finally, that which had been suspected or believed to be true—that tuberculosis was communicable—for so many years, nay, centuries, became a demonstrated fact. Isocrates, six centuries before Christ, believed tuberculosis to be contagious, as we have seen, and in 1638 Lazarus Riverius, in his "*Practice of Physik*," one of the chief works of medicine of his time, thus wrote: "Moreover there are causes of pulmonary phthisis, as contagion, which is chiefest, for this disease is so infectious that we may observe women to be infected by their husbands and men by their wives and all their children to die of the same, not only by heredity but from the company of him who was first affected."

In 1754 Florence enacted sanitary laws regarding tuberculosis and in 1782 Naples did likewise, isolating consumptives and destroying their belongings. In 1760 a special hospital was erected in Olibuzza for the isolation of consumptives to which they were removed from other hospitals. In Spain and Portugal similar precautions were taken. Physicians in Italy who did not report their cases of consumption were fined 300 ducats (between \$600 and \$700) for the first offense and for the second were exiled for ten years. Rather a more serious penalty for failing to report cases of the disease than that existing to-day. Physicians who refused to send their consumptive patients to the special hospital for such cases, or removed them without the knowledge of the officers of health, were given three months' imprisonment, if of low birth, or fined 300 ducats, if of noble birth.

Thus, after long years of observation, patient investigation and experiment, it was definitely established that consumption always took its origin in the tubercle and that it was communicable or infectious. The next step was to determine how the infection took place, what caused the tubercle? Was it a specific micro-organism which entered the body from the outside? Pasteur's remarkable researches upon the bacterial origin of diseases and those of Tyndall's upon "Floating Matter of the Air in Relation to Putrefaction and Infection" suggested this. So the investigations and discoveries in one department of science all unconsciously aid

in the solution of problems in another scientific domain.

Robert Koch (frontispiece), a German physician in a country town, conceived the idea that it was a specific "*contagium vivum*" which entered the body and set up the mechanism of the tubercle formation, and he set about to see if he could prove it. At about this time the new science of bacteriology and the method of differential staining was beginning to be developed, and the compound microscope had been improved and perfected and the Abbé condenser added. With this idea in mind of a specific micro-organism as the cause of tuberculosis, and with the new tools of bacteriology, staining, and the improved microscope, Koch set to work, and after long, patient labor and many failures, he succeeded in demonstrating in the tubercles of recently killed animals the rod-like microscopic structure which we know now as the tubercle bacillus. He invariably found these micro-organisms in all tuberculous tissues, in the lungs, scrofulous glands, tuberculosis of the bones and joints; in lupus in the sputum of consumptives and in tuberculous cattle; in brief, in all diseases which from their nature and structure could be considered as tuberculous.

The next point to be determined was whether this tubercle bacillus was the sole and invariable cause of tuberculosis. Was this constantly recurring bacillus an actual, independent organism, or was it the product of disintegrating tissue? To

prove this point Koch saw that he must obtain a pure culture of the bacillus and inoculate animals with it and see if tuberculosis ensued. After infinite pains and patience Koch succeeded in cultivating a pure crop of the tubercle bacilli upon a medium of blood serum. Now came the crucial step in the investigation: would these pure cultures of the tubercle bacillus produce tuberculosis in well animals? One can well imagine the intense expectancy of Koch as he proceeded to this last and deciding step in his experiment. He inoculated with his pure culture 217 animals,—94 guinea-pigs, 70 rabbits, 9 cats and 44 mice, and then with intense interest he awaited the result. His state of mind must have been similar to that of all great discoverers: Franklin with his kite and key in the thunder storm; Morse with his telegraph; Bell with the telephone; Marconi with wireless telegraphy. Not a single one of the animals inoculated escaped tuberculosis. At the same time Koch injected all kinds of diseased tissues into guinea-pigs and rabbits and the result was always negative to tuberculosis.

Thus finally the truth regarding the true ætiology of tuberculosis was revealed, after centuries of ignorance of its cause. By Koch's supreme achievement tuberculosis is known to the world as an infectious disease, the sole cause of which is the tubercle bacillus. Little by little, as we have seen in the foregoing pages, our knowledge of the disease increased and grew more definite through the

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study of the many investigators through the years, until the final consummation came.

So does "science move but slowly,
Slowly creeping on from point to point."

Koch issued an account of his discovery and its demonstration in 1882. As always with regard to any great discovery, some doubted his results, but no one was able to disprove them. As Osler has well said: "The enemy is known, its life history is known, the mode of entrance into the system is known, and this has been followed by the fourth stage in the history of the disease, the period of prevention."

CHAPTER III

PATHOLOGY AND BACTERIOLOGY

"Diseases are often to be traced by visible changes of structure in the internal parts of the body. . . . They throw light upon what is past; they afford some guidance for the time to come."

Thomas Watson.

The tubercle bacillus is an infinitesimally small, slender rod, in length from one-quarter to one-half the diameter of a red blood corpuscle. It is frequently more or less curved, and sometimes has an irregular knobbed appearance. When once well recognized in its red color, its characteristic appearance can never be forgotten or mistaken. It may occur in chains or in small clumps. It is a parasite and does not multiply outside of the body, except when grown upon a favorable medium. It belongs to the class of acid fast or acid proof bacilli and its envelope is penetrated by stains with difficulty. Acids do not remove the stain. It is a long lived, tough parasite, and under favorable conditions may retain its vitality for several months. Hidden away in dark, damp corners, it lies in wait for its victim, or mounted upon particles of dust, it roams about ready to be inhaled by any one living in the dust-laden atmosphere. Floating on dust

in the air, the bacillus may retain its infectivity for eight or ten days.

It is destroyed by sunlight in a few hours, and by diffuse daylight in twenty-four hours. Various germicides kill it; for example, a five per cent. solution of carbolic acid added to an equal volume of sputum will kill the bacilli in twenty-four hours. So will a two per cent. lysol solution, or a fifteen to twenty per cent. solution of formalin. An equal volume of the disinfecting solution must be used and thoroughly incorporated with the sputum. It must be borne in mind that when the tubercle bacilli are enclosed in mucus it requires a longer time to destroy them. Heat at a temperature of 150° to 160° F. also kills the bacilli when moist in from ten to fifteen minutes. When dry, it requires a higher temperature for a longer time. In milk, a temperature of 140° to 167° F. continued for one hour is also effective. Pasteurized milk (heated to from 155° to 158° F. for twenty to thirty minutes) can be considered safe. Cold to any degree has no destructive influence upon the bacillus. It will retain its vitality for a considerable time in decomposing animal tissues, and it has been found in the soil of sewage fields. The gastric juice, although it impedes its development, from its acidity, does not destroy it. It has been estimated from carefully obtained data that a consumptive may expectorate 500,000,000 to 3,000,000,000 tubercle bacilli in twenty-four hours. It is to be remembered that the dry bacilli retain their vitality for a

long time, and hence the danger in a room where there is an unclean consumptive who allows his sputum to become dry and coughs in the air.

Besides the human tubercle bacillus there is that of the bovine type which differs from the former in action and slightly in form. It is shorter, straighter, and thicker, and is more virulent for rabbits. Whether these two forms are distinct types or variations of a single type is a question still under discussion. Both produce tuberculosis in man and animals, although the human tubercle bacillus less readily infects cattle than that of the bovine type.

The tuberculosis in children under five years of age in the form of tuberculous glands and abdominal tuberculosis has been found, in a certain number of cases, to be due to the bovine tubercle bacilli ingested in milk. From the investigations of Park and others the conclusion has been reached that from six and one-half per cent. to ten per cent. of deaths of young children from tuberculosis are from bovine source through infected milk. The obvious lesson is to secure milk from cows proved to be non-tuberculous or to pasteurize it.

Staining the Tubercle Bacillus

The simplest and quickest method of staining the tubercle bacillus, and the one ordinarily employed, is that of the Ziehl-Nielsen, and the technique is as follows: The morning sputum is to be obtained if possible, and from it one of the grayish

particles having the most consistency, and as being the most likely to contain the bacilli, is selected and thinly and evenly spread over a cover glass or slide. This is dried by passing the glass rapidly three times through or over the flame of a Bunsen burner or alcohol lamp; thus the material is fixed. Next, this is stained with the carbol-fuchsine solution which is composed of saturated alcohol solution of fuchsine 11 c.c., and solution of carbolic acid (five per cent.) 100 c.c. Sufficient stain is used to entirely cover the film. This is then held over the flame for from thirty seconds to one or two minutes until steam arises, not allowing it to become dry. Wash in water and decolorize with the acid solution, which is composed of either nitric, hydrochloric or sulphuric acid in the proportion of five parts of concentrated nitric acid to 95 parts of alcohol (80 per cent.), a three to five per cent. of hydrochloric acid in 80 or 90 per cent. of alcohol, or a twenty per cent. of sulphuric acid. The preparation is alternately put in the decolorizing fluid and washed until the red color disappears. After the final washing it is counter-stained with Löffler's methylene blue solution, allowing the solution to remain on the glass for from thirty seconds to one minute. This is then washed off with water, the glass dried, mounted, and examined with the oil-immersion lens.

It is evident that a specimen of sputum may contain tubercle bacilli and yet the particular particle examined may give a negative result; and this is all the more likely to happen when there are but few

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bacilli in the whole specimen. In order to obviate so far as may be this possibility, two methods have been employed which have proved of much value, the object being to soften and concentrate the sputum and destroy other bacteria. These two methods are called (a) the antiformin and (b) the Ellerman and Erlandsen methods.

The Antiformin Method

Antiformin, which contains sodium hydroxide and sodium hypochlorite, is mixed with the specimen of sputum in the proportion of one part of the fluid to five parts of the sputum. This is allowed to stand for three or four hours, long enough for the sputum to soften; it is then diluted with water or alcohol and centrifugalized; the sediment is collected and again centrifugalized once or twice more, when the final sediment is stained and examined in the usual way.

The Ellerman and Erlander Method

For the technique of this method I am indebted to Dr. H. M. King of the Loomis Sanatorium where it is in use.

The entire expectoration of three days is collected in a clean wide mouth bottle. To this is added an equal volume of 0.6% sodium carbonate solution. After shaking, the mixture is placed in an incubator and allowed to digest at a temperature of 37° C. for twenty-four hours. The time of digestion should be increased with thick purulent

specimens. The mixture is removed from the incubator, and should consist of two layers; the upper cloudy fluid, the lower a varying amount of homogeneous sediment. The entire fluid portion is poured off (into 5% lysol or similar solution), and to the remaining sediment is added four or five volumes of 0.25% sodium hydrate solution. The mixture is next transferred to a suitable vessel and boiled for one or two minutes. Large test tubes (eight by one inch) or small beakers are found convenient. After cooling, the mixture is transferred to 50 cc. centrifuge tubes and centrifugated for ten or fifteen minutes at high speed. The resulting sediment is smeared upon two or three slides, making rather thick smears, and then stained in the usual manner.

It is hardly necessary to add that when the sputum is examined in the ordinary way, a single negative result is not conclusive evidence that tuberculosis does not exist if there are suspicious or definite symptoms and physical signs. Under such circumstances one would not infrequently be deceived if he rested content with a single negative examination. The sputum should be examined several times by the ordinary method, or by one of the two methods given above, before a definite conclusion is made that the sputum is bacilli-free; and even then, if there are definite symptoms and signs not referable to other causes, a tentative diagnosis of tuberculosis should be made.

Entrance of the Tubercle Bacillus into the Lungs

The tubercle bacillus reaches the lungs in two principal ways: (a) directly through the respiratory passages, by inhalation, and (b) indirectly by way of the gastro-intestinal canal, by ingestion. Which is the more frequent path is still a debatable question, but the weight of opinion seems to be in favor of the inhalation route.

Action of the Tubercle Bacillus. History of the Tubercle

When the tubercle bacilli have gained entrance into the lungs by one or the other route, they may be destroyed and leave no evidence of their visit, or they may produce certain inflammatory changes peculiar to their specific nature, just as other irritants or specific bacteria cause inflammatory phenomena peculiar to their specific influence. As with all forms of inflammation, we may have resolution, necrosis or ulceration, and a reparative tendency, as the formations of fibrous tissue. The tubercle bacillus by its irritant effect either gives rise to the formation of the characteristic tubercle, composed of epitheloid, lymphoid and generally giant cells with a reticulum of fibrous tissue; or else to a diffuse tuberculous infiltration with few if any distinct tuberculous nodules; or to a tuberculous exudative inflammation, as in tuberculous pneumonia.

Individual tubercles coalesce and form a nodule

or conglomerate tubercle, and when a certain stage is reached in its development, degeneration or necrosis takes place in its center, of a specific form called caseation or softening. This caseation is one of the characteristics of all forms of tuberculous inflammation in the lungs. In acute tuberculosis this softening progresses uninterruptedly with little or no attempt at repair, but in the chronic form nature attempts to limit or strangle the tuberculous focus by fibrosis, the formation of connective tissue, and this is the way in which healing takes place. The tuberculous tissue or tubercle may be directly transformed into fibrous tissue, the most perfect form of healing, but this, unfortunately, does not often happen after the disease has become established. The caseous mass may become calcified to a greater or less extent, thus limiting its destructive influence, or it may be surrounded by a fibrous envelope, encapsulated. Within this envelope, however, there are often virulent tubercle bacilli, which may burst their bonds and produce further disease; or the escaped bacilli may enter the blood stream and acute miliary tuberculosis ensue.

Caseation and fibrosis do not usually go on separately, but simultaneously, and the result depends upon which process finally becomes supreme. The formation of fibrous tissue generally takes place at one part of the tuberculous area, while the disease slowly spreads at another. When extensive caseation or softening occurs, cavities are formed. In active tuberculosis the toxin of the tubercle bacillus

produces, as in other infections, certain constitutional disturbances, such as fever, rapid pulse, loss of weight and strength, and other evidences of a systemic infection.

In quiescent cases, however, we may have very extensive disease with little or no disturbance of the general health; the individual may have the appearance of perfect health, may be able to follow his usual mode of life, and feel as well as ever.

The tubercle bacillus cannot be destroyed *in situ*, although many attempts have been made to do so. Likewise, innumerable attempts have been made to directly excite the formation of connective tissue, but none of the especial methods tried have been successful. The only hope of arresting the disease is to aid nature in her efforts to form fibrosis, and the only successful method of accomplishing this is the general plan of increasing and maintaining the general resistance of the individual by all the means included in the "open-air" treatment.

Post Mortem Appearances of Tuberculous Lungs

The changes seen in the lungs of one who has succumbed from tuberculosis are varied, depending upon the form and stage of the disease. In acute miliary tuberculosis, the lungs are studded with nodules of miliary tubercles, and there is general congestion. In acute tuberculous pneumonia, we have the characteristic exudative changes, as in non-tuberculous pneumonia, and, in addition, caseation — softening — and the production of cavities.



Fig. 7. "Both upper lobes contain cavities and large amounts of fibrous tissue. Section of left lung illustrated shows upper lobe converted almost entirely into fibrous tissue with several small cavities. Caseated tubercles in the lower lobe."

From U. S. Army General Hospital, Fort Bayard, N. M.

In the more common fibro-caseous form, we find tubercles or nodules, areas of inflammatory infiltration or consolidation, with caseous — softening — ulceration, the formation of cavities, and the production of connective tissue — fibrosis — in the attempt to arrest or limit the disease. The longer the disease has existed and progressed, the greater the destructive changes, as indicated, for example, in huge cavities. (Fig. 7.)

Mixed Infection

The tuberculous lesions offer a favorable medium for other micro-organisms, and in more or less advanced cases, various other pathogenic bacteria are frequently found, such as the streptococcus, pneumococcus, staphylococcus, and the influenza bacillus, in friendly companionship with the tubercle bacillus. This alliance makes a bad matter worse and by their united toxic effect intensifies the symptoms. The fight then becomes one between the allied armies of the tubercle bacillus and the other pathogenic organisms, and the army of the resisting host.

Extension of the Disease

From the initial focus the tubercle bacilli may be carried to other parts of the lung or to other organs or portions of the body. Such migration may take place by the route of the blood, the lymphatics, or by the natural channels which lead from the diseased focus to other parts of the organ or to the bronchi.

Cavities and Fibrosis

Softening, if continued, leads to the formation of cavities. Several cavities may occur in the same lung, and they may unite. If the resistance overcomes the infection, the cavities may cease to grow; the destroyed material is eliminated and cicatricial tissue may form in the cavity walls — a reparative process. If this fibrosis predominates, we eventually see the cavity filled with a thick fibroid mass, and contraction takes place. The predominance of the fibroid process may exist from the first and form the characteristic feature of the disease. When this happens, the progress of the disease is slow and the constitutional symptoms comparatively slight, dyspnoea being the most prominent symptom. When fibrosis is the chief pathological feature, the name fibroid phthisis or fibroid tuberculosis is given to the disease.

True Healing

Genuine healing can only be said to have occurred when all caseous material is destroyed and calcified deposits or connective tissue replaces it. The healed focus then has the appearance of a puckered cicatrix. Encapsulation of the caseous mass is not true healing, though it is an arrest of the disease, for living tubercle bacilli may be contained within the encapsulating envelope.

Cause of Hemorrhage

The slight or moderate hemorrhages which occur in one-half or more of all cases of pulmonary tuber-

culosis, generally result from the rupture, through ulceration, of a small vessel in the diseased area, or from exudation. Extensive and often fatal hemorrhages are generally caused by the rupture of an aneurysmal enlargement of a vessel projecting into a cavity.

Infection and Period of Incubation

How long after the implantation of the tubercle bacillus acute manifestations of the disease occur, we do not know. We know, however, that the development of the infection is generally slow; months or years may elapse before active symptoms appear, or they may never occur. We believe also that infection is not caused by a transitory exposure to the bacillus, but by a continuous and oft-repeated one. Hence we call tuberculosis a house disease, for in the house where there is one individual suffering from the disease, others who are constantly associated with him are more likely to become infected, as investigation and experience have shown.

Predisposition: Acquired; Inherited

(a) Acquired:

Not every one, however long he may be exposed to the tubercle bacillus, becomes actively infected. In order that this may happen, one must have an inherited or acquired predisposition. We can only guess as to what causes this predisposition or receptive state. In general one can predicate that whatever influence, long-acting, which lowers the

normal resistance, produces a favorable soil for the bacillus, an *acquired* predisposition. Such influences are legion: unwholesome conditions of living and working, dusty occupations, lack of sunlight and fresh air, over-fatigue, under-feeding, insufficient rest and sleep, are some of the chief of these influences. Certain diseases, as recurrent bronchitis, measles, whooping cough, the "grippe," diabetes, also appear to be predisposing influences. As the majority of adults have some tuberculous infection, and yet so many escape the active disease, it is evident that the difference in individuals as to their susceptibility depends upon the resistance of their tissues rather than upon their resistance to infection.

(b) Inherited:

What part inheritance plays in the receptivity of the organism we cannot say. Of course, the old idea of the direct inheritance of the disease is no longer tenable in the light of our present knowledge of its infective nature. The frequency, however, with which tuberculosis occurs in those of tuberculous parentage would seem to indicate the probability of an inherited susceptibility. Nevertheless, this is by no means certain, and it may only mean that a weakened body is inherited from those debilitated by a wasting disease, like tuberculosis, and hence the organism is less resistant to tuberculous infection, to which it is more likely to be exposed than to any other infection. "It seems perfectly

plain," says Davenport¹ considering the question from an eugenic standpoint, "that death from tuberculosis is the result of infection added to natural and acquired non-resistance."

Acute Tuberculosis

Generally in speaking of pulmonary tuberculosis, one refers to the chronic fibro-caseous form; but, as in all inflammatory conditions, we have also acute tuberculosis in which the caseous element practically alone exists, and the disease is purely destructive and acute from start to finish. There is no resistance on the part of the organism and the infection has its own way without hindrance. We have the lobar-pneumonic and the broncho-pneumonic forms. Acute miliary tuberculosis stands rather in a class by itself.

Acute Miliary Tuberculosis

Acute miliary tuberculosis is always a secondary infection from a pre-existing tuberculous focus somewhere in the body, from which there is an eruption of tubercle bacilli into the blood stream which carries them to the various organs of the body. This untoward event may happen as the terminal stage of a chronic tuberculosis, or may occur in an individual in which the original disease appeared to have been arrested or was in a quiescent condition.

¹ "Heredity in Relation to Eugenics," by Charles Benedict Davenport, New York, 1913.

It is often quite impossible to make a diagnosis of acute miliary tuberculosis, the physical signs are so indeterminate. It resembles typhoid fever and can be mistaken for it. It also simulates acute bronchitis of the smaller tubes. One should seek for evidence of tuberculosis in other parts of the body. The marked discrepancy between the physical signs and the symptoms of extreme dyspnoea, cyanosis, great prostration, and the lower and less continuous temperature with the one distinctive physical sign of fine, moist rales throughout the chest, heard perhaps only after cough, are the most important guides to diagnosis.

It is always acute and almost invariably fatal. It is the overwhelming toxic influence of the bacilli which produces the profound depression and the fatal issue. It is the drive of a victorious invading army overcoming all resistance. It runs its course in from a few days to a few weeks.

The treatment can only be symptomatic. An example:—A patient came to my clinic upon Tuesday with great prostration and fever. Upon physical examination only fine, moist rales were found in his chest. He was referred to the hospital where he died on the following Friday. The autopsy revealed general acute miliary tuberculosis. Fortunately, this dire form of tuberculosis is not common, but in cases resembling typhoid fever, when the Widal reaction is negative, and other signs of the disease are absent, acute miliary tuberculosis should be borne in mind.

Acute Lobar-pneumonic Tuberculosis

In this form of acute tuberculosis the general symptoms and physical signs so nearly simulate ordinary lobar-pneumonia that in the early stages it is quite impossible to make a differential diagnosis unless, fortunately, tubercle bacilli are detected in the sputum, which, however, is rarely the case in the early stage of the disease. One becomes suspicious when resolution does not occur at the usual time; but even then the case may be regarded as one of delayed resolution. As time goes on, however, the real nature of the disease becomes revealed. The fever continues; flesh and strength rapidly fail; the expectoration becomes more profuse and purulent; and spots of softening in the consolidated lung followed by the formation of cavities are detected. Tubercle bacilli will be found in the sputum, if they have not appeared before. The disease may proceed steadily on without remission, and the fatal end come in a few weeks. On the other hand, the severer symptoms may abate and the case become subacute and be prolonged for from two to six months. In every case of pneumonia one should always bear in mind the possibility of tuberculosis.

Acute Broncho-pneumonic Tuberculosis

This is the more common form of acute tuberculosis and is the one to which the name of "galloping consumption" has been given on account of the rapidity of its course. The clinical picture is quite

different from that of the previous form, but the diagnosis in the early stage is equally difficult. The symptoms are not as pronounced or severe as in the lobar form.

It is very common in childhood and youth, following measles and whooping cough, or as a complication of "grippe," typhoid fever and diabetes. It may also follow hemoptysis. The symptoms and physical signs are at first those of an ordinary broncho-pneumonia. In the beginning it may resemble an attack of "grippe." The advance is rapid. Soon we find areas of consolidation with moist rales, shortly followed by softening and the appearance of tubercle bacilli in the purulent expectoration. The symptoms are marked and markedly out of proportion to the physical signs, which is a diagnostic point. There is rapid emaciation; extreme prostration; night sweats; dyspnea, anorexia, severe cough and continued high fever. The course of the disease is generally from two to six months, or it may be only a matter of weeks. The end generally comes from exhaustion, or meningitis, or hemorrhage may hasten it. As in the previous form, the acute symptoms may practically subside, and a more or less chronic stage supervene, but recovery is very rare.

Age Period and Resistance

As with most other infectious diseases, pulmonary tuberculosis occurs most frequently in youth and early adult life, the most common age period

being from fifteen to thirty-five or forty years of age, although no age is exempt from it. Infants and young children show the least resistance, and in later life, after fifty years of age, the resistance is again lowered, although the disease at this age period has a tendency to be very chronic. The resistance is greatest between twenty-five and fifty years of age.

The Common Form of Tuberculosis

The chronic or fibro-caseous form of pulmonary tuberculosis is the most common one and is that with which we shall hereafter have to deal. It is the type to which we commonly apply the term "consumption." As the name "fibro-caseous" indicates, the two processes, caseation — destruction, — and fibrosis — repair, healing — go on together. The opposing foes, the infection and the resistance, have entrenched themselves for a long war. Many sallies take place from one or the other side; and as one or the other opposing forces holds the ground taken and steadily advances, so the final issue will be determined. If the tissues of the body are able to restrict and limit the growth of the bacilli and their advance into new country, and overcome the baleful effects of the toxins, then victory is assured and the disease arrested. All treatment can do is to equip the resistant powers of the body to do their best work. Treatment furnishes the munitions; resistance must use them.

CHAPTER IV

DIAGNOSIS

"Find out the cause of this effect."

"Or rather say the cause of this defect."

"For this effect defective comes by cause."

Hamlet. Act II. Sc. 2

"The physician ought in the first place to endeavor to ascertain the nature and state of the disease by the common symptoms alone."

John Forbes.

Early Diagnosis

The early diagnosis of clinical or active pulmonary tuberculosis is easy or hard very much as one goes about it. Generally, I believe, the physician will be able to make a definite or probable diagnosis if he diligently studies his patient's condition in a methodical manner, correlating and combining the symptoms and carefully weighing their evidence. He must ever bear in mind that the symptoms usually reveal more than do the physical signs, which are so often indefinite. If at the first examination he is unable to arrive at a conclusion, he can keep the patient under observation and subsequent examinations may resolve the doubt.

Suspicious Symptoms

What are the indications which would lead one to suspect tuberculosis? There are a number of suspicious symptoms, any one or several of which suggest it:

(a) A persistent cough, which may be and often is so slight — perhaps occurring only in the morning — that it is not admitted by the patient except upon careful questioning. “When there is a long persistent and otherwise unexplained cough,” says Wilson, “accompanied by either a subnormal temperature or one that rises slightly in the afternoon a probable diagnosis of tuberculosis should be made.”

(b) A loss of bodily vigor or strength; one becomes more easily fatigued than was his wont; as the patient often expresses it, he has “lost his courage,”— he doesn’t feel up to his work.

(c) A loss of weight which may be so slight that the patient is unaware of it until the scales prove it.

(d) A slight and persistent rise of temperature in the afternoon.

(e) A rapid pulse persistently above the normal in frequency, not always present, however, but generally so in active tuberculosis.

(f) Slight shortness of breath on exertion.

(g) Loss of appetite not infrequently accompanied by digestive disturbances.

(h) Pain in the chest, frequently the only symptom which brings the patient to the physician. I

have not found this symptom of much importance in indicating any tuberculous lesion, but it should always be followed up by a careful examination. Says Norris: "There are four easily ascertained and highly suggestive symptoms, the existence of which should always arouse our suspicion, unless their presence can be explained upon other grounds. They are: (1) rapid pulse; (2) evening rise of temperature; (3) loss of weight; (4) cough"; and I would add a fifth, namely, loss of strength. "The protracted existence of any two of these symptoms," continues Norris, "requires a good cause to be shown why the diagnosis of pulmonary tuberculosis should not be made."

"Always say three things," says Gee, "to a patient whom you suspect to be tuberculous":

(1) "Get yourself weighed, by the same machine each time, to see if you are losing weight."

(2) "Use a thermometer two or three times each evening to see if there is any fever."

(3) "Save your sputa to be tested (for bacilli)."

Hemoptysis is a symptom which almost invariably brings the patient to the physician, for there is nothing that alarms him more. It may be slight, only "streaked sputum," or it may be a mouthful or more. It is the nearest approach to a pathognomonic symptom, and unless a definite source in the upper respiratory tract is discovered, or a cardiac lesion is found, it should be taken to mean

pulmonary tuberculosis even if no physical signs are detected and the patient otherwise appears to be in good health. For example:— A student came to me with the history of a slight hemoptysis after some unusual exertion. He had no other symptoms, and, so far as he knew, was perfectly well. There were no abnormal physical signs. He continued in his work and no other symptoms developed. Six months later he had another similar experience, again from some unusual exertion, and again there were no other symptoms or signs. An X-ray picture, however, was taken which showed a small spot in one lung. He was sent to a sanatorium and later discharged with the report that they could find nothing the matter with him.

There are various other slight suggestive symptoms which should demand an examination of the lungs, for, as Lawrason Brown well says, "in few other serious diseases do we have to depend so much upon slight symptoms for early diagnosis." Such other symptoms are (1) chilliness, complained of after some slight exposure to cold or wet or a draft of air; (2) undue nervousness, which is often considered only a neurasthenic symptom; (3) pain and stiffness in the joints; (4) in women amenorrhœa, although this does not usually occur in the incipient stages; (5) sweating after slight exertion; (6) anæmia; (7) recurring colds; (8) persistent or intermittent hoarseness; (9) various digestive disturbances: Fistula-in-ano is a tell-tale symptom,

and the diagnosis of malaria has been made, whereas the supposed malarial symptoms were really those of the toxæmia of an active tuberculosis.

Sometimes one may come for an examination of the lungs, as many do now, presenting no evidence that the disease exists, but merely to see if he is "all right." Having determined then, for one reason or another, to make an examination of the person as to tuberculosis, the first step is to obtain the history, past and present, and follow up all clues. For the sake of method and thoroughness, a definite plan or scheme should be followed in doing this, and there are many such excellent outlines. Some have the fault, in my opinion, of being too redundant. My own is as follows:

Scheme of Examination

Name			
Date		Residence	
Age	M. S. W.	Occupation	Race
FAMILY HISTORY			
EXPOSURE TO INFECTION			
PAST HISTORY			
HABITS		Venereal	Alcohol
Tobacco			

PRESENT ILLNESS: date and mode of onset. What definite thing does the patient complain of?

Cough		Appetite
Expectoration		Digestion
Loss of Weight;	of Strength	Pain
Dyspnoea		Ability to work
Night Sweats		Menstruation
Hemoptysis		Fever

A routine procedure in the examination is of obvious advantage in eliciting certain definite facts

bearing upon a possible tuberculosis, but at the same time the patient should always be allowed to tell his own story in his own way which will not infrequently bring out important evidence not obtained by the questionnaire. Every circumstance in the patient's life, however unimportant it may seem in itself may, when taken with other evidence, aid in the diagnosis; the name even, indicating the nationality, may suggest the conditions under which the patient has previously lived. So may the age, residence and domestic relations have a bearing upon both diagnosis and prognosis.

Occupation

The occupation is significant. Is it an indoor or outdoor one? Is it pursued under a favorable or unfavorable environment? Is it, for example, a dusty occupation? For the incidence of tuberculosis is materially greater in dusty occupations, especially where the dust is metallic or mineral. Is it an occupation which requires excessive mental or physical demands and close confinement? One which does not allow proper time or opportunity for meals, rest, fresh air and recreation?

Family History

If there is a history of tuberculosis on the paternal or maternal sides indicating a possible inherited predisposition, it is a help; but if negative it is of little importance. The family history, however, if one has time to follow it up, and the patient knows

it, will tell us something of the vigor, longevity and tendencies of the family stock. Some families are apparently inclined to certain weaknesses, or diseases, such as bronchitis, digestive disturbances, an unstable nervous system, rheumatism, etc., we can also learn something of the mental and physical traits the patient has inherited or what defects have been handed down to him.

Exposure to Infection

A history of exposure to a tuberculous infection, long continued and close, as from a case in the family, is of far greater importance than the fact of family inheritance, "than the fact," as Brown says, "that the forebear of the patient, one whom he has never seen, has had or died of tuberculosis"; for investigation has shown that when one case of tuberculosis exists in the family, it is more than likely that other members of the same family may acquire the infection. Not infrequently, also, prolonged and intimate association with an active tuberculous individual in workshop, factory or office has led to the communication of the disease from the infected person to the well; for example, a young woman, suffering from tuberculosis, a secretary in an office, was undoubtedly infected by her tuberculous employer who was careless in the disposal of his sputum.

Past History

Under this head, we may learn little or much, depending upon the inquisitiveness of the physician

and the responsiveness and intelligence of the patient. What we desire to learn is the life history of the patient in childhood and adult life up to the time of examination. We wish to know what children's diseases he had, particularly measles and whooping cough, for there is evidence to show that these two infections render the lungs more susceptible to a tuberculous infection. Was he a vigorous or sickly child? What was his environment and nurture in childhood and youth? In adult life did he suffer from any serious disease, such as typhoid fever, which sometimes is not typhoid fever at all but the awakening into activity of a latent tuberculous infection which again subsides? Such, also, may have been the real nature of a supposed attack of influenza. Has he ever had pleurisy, which, as we know, is secondary to a tuberculous infection in a large number of cases? Other suggestive diseases are recurring bronchitis, bronchopneumonia, diabetes, and neurasthenia. One should also inquire into the past or present existence of syphilis which is sometimes associated with tuberculosis and is a predisposing cause thereto, and is also sometimes mistaken for the latter disease. If any doubt exists a Wassermann test should be made.

Habits

From this inquiry, we learn the patient's routine of life, and whatever excesses he may have indulged in, although he will generally seek to minimize any bad habits in order to make out a good

story. The use of alcohol, either habitually or spasmodically, is an important question to determine, for, as some one has said, "alcohol makes the bed of the consumptive," and its constant employment undoubtedly lowers the resistance; moreover, it is likely to interfere with proper and regular taking of food. As to tobacco, I have never been able to determine that it has any special influence as a causative factor, unless used in excess, or the smoke is inhaled, as with cigarette smoking. I have never seen a moderate use of tobacco with patients accustomed to it do harm unless there was some special contraindication.

Present Illness

Under this head we seek to learn what symptom the patient first noticed which suggested to him the possibility of tuberculosis and when this first occurred. Hawes¹ thinks it better to ask the patient when he last felt perfectly well rather than when he first felt sick. As to the first symptom observed — the patient will generally give one or more of those enumerated in the beginning of the chapter which may here be repeated: (a) A persistent cough or cold with a little expectoration; (b) loss of weight; (c) loss of strength or nervous energy; (d) slight dyspnoea on exertion; (e) hemoptysis, generally slight; (f) chilliness followed by flushing or a feeling of undue warmth, indicative of fever; (g) pain in the chest, or pain referred to the shoulder blade;

¹ "Early Pulmonary Tuberculosis," J. B. Hawes 2d, Wm. Wood & Co., New York, 1913.

(h) hoarseness; (i) loss of appetite with digestive disturbances, all of which are specifically inquired into by the air of the questionnaire in the scheme.

Of all the symptoms, I agree with Hawes, that there is no more common one than "loss of ambition or energy." As one patient expressed it, he had lost all his "ginger." Again, the patient will date the beginning of his trouble from an attack of influenza, bronchitis, pleurisy or pneumonia. One must be sure that correct answers are obtained from the specific questions; for example, the patient may at first say that he has no cough or expectoration, but on careful inquiry we may elicit the fact that he has to "clear his throat" in the morning and raises a "little ball of sputum"; and in the "ability to work" he may not feel able to work, but yet is working from necessity.

While obtaining the history as outlined above, the keen physician will have learned much about the general character and physical condition of his patient by carefully observing his general appearance, actions, nervous condition, manner of answering questions, etc.

Importance of Symptoms

In early cases of pulmonary tuberculosis, one cannot be too painstaking in eliciting and studying the *symptoms*; for upon them we shall have to depend largely and sometimes entirely for our diagnosis. It must always be remembered that "symptoms frequently appear when no physical signs can be detected in the lungs." To depend upon indefinite,

doubtful physical signs to the neglect of a careful study of the symptoms will often lead to an erroneous diagnosis. On the other hand also, remember that physical signs without symptoms mean only that there is a tuberculous infection and not active clinical tuberculosis, and therefore, because physical signs are detected and there is *no other evidence* that the patient is ill, he should not be removed from his occupation and family life, which may "blast his whole career and life, prevent marriage and self-support." This, unfortunately, has sometimes happened in the eagerness to make an early diagnosis from physical signs alone without carefully considering the symptoms.

Physical Examination

We come now to the physical examination of the patient, and in order to proceed methodically, it is well to have a plan or scheme, with a diagram of the chest upon which to note our findings. The following simple one is that which I find useful (Fig. 8).

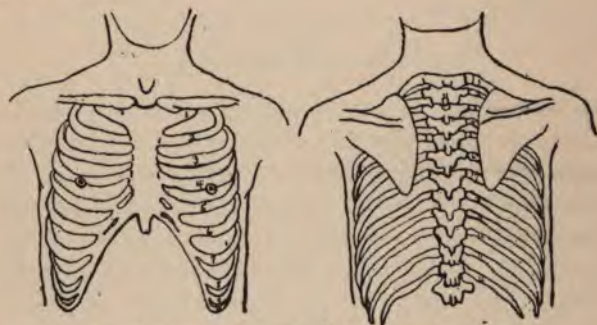


Fig. 8. Diagram for indicating physical findings

Examination of the Chest**(a) Position of the Patient:—**

The patient should, in all cases, be stripped to the waist, with a sheet or some covering thrown about him, and seated upon a revolving stool. It takes considerable time for a careful examination and it is less tiresome both for the patient and physician to be seated than to stand. The arms should hang loosely by the side when examining the front of the chest, and when examining the back the arms should be folded or one hand placed upon the opposite shoulder when examining one or the other space between the scapula and the vertebræ for by this maneuver the scapula is pulled outward and one obtains more space between it and the spinal column. In examining the axilla, the hand should be placed upon the head.

(b) Inspection:

In inspecting the chest one should not be content with looking at it from the front, but also from the side and over the patient's shoulders. One should notice (a) the shape of the chest, as a whole, giving especial attention to the spaces above and below the clavicle to see whether there is more depression on one side than the other; (b) the appearance of the skin, its color, prominence of the veins, and any excrescences, such as swellings, and the neck should also be examined in this connection for scars indicating former adenitis, or for existing glands; (c) the respiratory movements, not only of the upper part of the chest, but also the diaphragmatic respira-

tion. Particularly to be noted is delayed expansion, or less movement at one apex than at the other, which, when one can be sure of it, is a sign of value in early diagnosis.

Pulse and Respiration

The pulse and respiration should not be taken until the patient has had time to rest and become accustomed to the situation. If taken when he is more or less excited upon the first visit to the physician, they will generally be above the normal rate. A much increased pulse rate, as has been observed, is of material significance, but in my experience, rapid respiration is of less importance, although it is suggestive.

Examination of the Upper Respiratory Tract

Before or after the physical examination of the chest, the upper respiratory tract should be investigated:—the nose, pharynx and larynx, and their condition and color of the mucous membranes noted. An anæmic, relaxed mucous membrane in these parts is often observed in pulmonary tuberculosis.

The Weight

First, the weight is taken with accurate scales and compared with the normal weight so far as we can learn it from the patient or estimate it. "In the diagnosis of early tuberculosis," says Lindsay, "the weighing machine plays a part hardly less important than the stethoscope or the thermometer,

for wasting in some degree is one of the most constant symptoms."

The Temperature

The temperature taken once in the physician's office at whatever time the patient happens to be there is of little value unless it is 100° F. or more. To obtain the real temperature variations, it should be taken at 8 A. M., 12 M., 4 and 6 P. M. for a period of a week, and the patient can readily be instructed to take it himself, or some one in the house can do it for him. A constant although slight rise of temperature (99.5° or over) usually occurring in the afternoon, or a subnormal temperature if accompanied by a persistently rapid pulse is very significant. When these two conditions, viz., a slight rise of temperature in the afternoon or a subnormal temperature and a rapid pulse are present and at the same time they are accompanied by a little loss of weight and strength and undue nervousness, the case for the existence of pulmonary tuberculosis is a strong one. It is to be borne in mind that the above symptoms resemble those of neurasthenia and a diagnosis of the latter should not be made without a careful investigation as to the condition of the lungs.

Outline of Percussion and Auscultation Sounds

The following brief sketch of percussion and auscultation sounds will refresh one's memory as he proceeds to employ them in the next step of the examination.

Percussion

Prolonged practice is necessary to acquire skill in the practice of percussion.

The sound which we obtain in percussing the lungs is called the *percussion note*.

Percussion sounds have certain attributes or characteristics just as other sounds do, as the sound of a cannon, a violin, or a bell. Those attributes are: (a) quality; (b) intensity or loudness; (c) pitch,—high, low or intermediate; (d) duration (of least importance).

The qualities of sound produced by percussing the chest may be included under three divisions:—

I. Normal vesicular, or clear,—the sound given out by the healthy lung. Under this head we may include an abnormally clear sound called “hyper-resonant,” found in emphysema for example.

II. Dull sound, with the subdivisions: (a) slight dullness, (b) moderate dullness; (c) absolute dullness (flatness), present in varying degrees of consolidation, pleural effusions, thickened pleura, pulmonary œdema, hemorrhagic infarction, and, in general, when the solids or liquids within the chest are abnormally increased without increase in the quantity of air (Flint).

III. Tympanitic sound: a clear, hollow sound of a drum-like quality, such as heard in percussing a distended stomach or in a pneumothorax. It is devoid of all vesicular quality. This sound is elicited in more or less purity in pneumothorax, and



Fig. 9. Auenbrugger

in cavities containing air. Varieties of tympanitic sounds are: (a) amphoric sound; occurring over a pulmonary cavity and in some cases of pneumothorax; (b) the cracked-pot sound, most often heard over large superficial air-containing cavities, and is the most infallible sign of a cavity known; is sometimes found in relaxed and infiltrated tissue (pleurisy and pneumonia).

Pitch: The greater volume of air over which we percuss, the *lower* the pitch, and as the volume of air is diminished, pitch rises, like the large and small pipes of an organ; hence pitch is lowest in the tympanitic sound and highest in the dull sound. The first suggestion of impaired resonance is a slight heightening of pitch, a shallower sound: we commonly call it, however, "slight dullness."

Duration varies inversely with pitch; that is, the higher pitch the shorter duration, and vice versa. A deep toned bell vibrates longer than a high, shrill toned one. Intensity or loudness of sound depends upon thinness of chest walls and force of percussion.

Auenbrugger's dictum (Auenbrugger discovered percussion and published a treatise upon it in 1761): — Fig. 9.

"Sonitus vel altior, vel profundior; vel clarior, vel obscurior, vel quandoque prope suffocatus apprehenditur."

"The sound (i.e., the percussion sound) is a tone, clear or muffled, even to complete privation.' This is the first and great distinction. And next,

'the tone is of a pitch higher or lower.' Upon these two hang the whole theory and practice of percussion."¹

Auscultation

Laennec, a celebrated French physician, discovered auscultation and published his first treatise upon it in 1819. Before Laennec, "clinical observation though never blind had been always deaf." Fig. 10.

Auscultation of the lungs is practiced with reference to three kinds of sounds:—

- I. The sounds of breathing.
- II. The voice sounds.
- III. New or adventitious sounds (rales, friction sounds).

I. The breath sounds: There are three general types of breathing,—(a) normal or vesicular; (b) bronchial; (c) cavernous. When the breathing is part vesicular and part bronchial it is called "broncho-vesicular," or "rough" breathing or sometimes "harsh."

(a) *Vesicular breathing*: Heard over normal lung. It may be normal in all respects and yet disease may exist, as in slight bronchitis, a few scattered tubercles, and early stage of pneumonia. Vesicular breathing may be altered as regards (a') intensity; (b') rhythm. (a') alterations in intensity: we may have (1) exaggerated vesicular breath-

¹ Gee "Auscultation and Percussion." London, 1893.



Fig. 10. Laennec

ing (also called puerile); occurs on healthy side of chest when the respiratory function of the other side is interfered with, *e. g.*, pleuritic effusion, pneumonia. (2) Diminished vesicular breathing (also called senile). Occurs when there is a thin layer of fluid between lungs and chest wall, or a thickened pleura, in emphysema, and in some cases of tuberculosis. (In large pleural effusions the respiratory sound is generally entirely absent.)

(b') Alterations in *rhythm*. (1) prolonged expiration; occurs for example in emphysema (may or may not be a sign of disease). (2) Jerky or cogwheeled respiration, an uncertain sign, not of great importance.

(b) *Bronchial breathing* (heard normally over trachea and at level of seventh cervical and upper five or six dorsal vertebræ). Occurs in disease in the following conditions: (1) consolidation of the lungs; from whatever cause (2) some cases of pleural effusion; (3) collapse of the lungs; (4) in certain cavities when the conducting bronchi are free. (Tubular breathing is an intense bronchial breathing with a metallic quality.)

Broncho-vesicular or "*rough*" breathing: Occurs in different degrees of solidification of the lungs, *e. g.*, in tuberculosis, pneumonia. The essential characteristics of broncho-vesicular breathing are a lengthening of the expiratory sound, and a roughening of both inspiration and expiration, and it means that more or less consolidation has taken place.

moist rales are caused by the passage of air through liquid, which may be blood, mucus or serum. We have moist rales in bronchitis, œdema, pneumonia, tuberculosis hemorrhagic infarction, during and shortly after an hemoptysis, atelectasis.

Friction sounds or *pleural rales* indicate pleurisy. Sometimes we have a coarse rubbing and sometimes an explosion of fine rales or what sounds like that. They are most commonly heard in the lower axilla. Cough does not affect friction sounds.

It is an economy of time and convenient for subsequent reference to indicate upon a diagram of the chest, front and back, the abnormal physical signs detected, and for this purpose some system of signs is necessary. The one I have employed for many years is the following which is very simple and answers the purpose sufficiently well. It is hardly necessary to say that the *whole* chest should be examined, front, back, axillary region and base. It is true that, if tuberculous infiltration is present, evidence of it will almost always be found either in the supra- or infra-clavicular region, the supra-spinous fossa, or the inter-scapular space; still, there are exceptions and one should always examine the entire chest.

Systems of Signs for Recording Findings

<i>Dullness on Percussion</i>		<i>Respiration</i>
Questionable dullness	I	Diminished or feeble:—"Resp.
Slight dullness	II	—" (minus), or > (Dim.)
Moderate dullness	III	Respiration increased =
Marked dullness	IIII	" Resp. +" or ++
Flatness or intense dullness	IIII	Expiratory murmur increased = " Exp't'n +."

Dullness on Percussion

Tympanitic = "O"

Cracked Pot = "C. P."

Respiration

Broncho-vesicular Resp. =

"B. V. (+ or ++)"

Bronchial Resp. = "Br."

Amphoric = "Amph."

Cavernous = "Cav."

Rales

If not heard with ordinary

— "c'gh."

With full inspiration — "c'
respiration state with cough
full insp."

Fine dry "dry clicks"

Fine, medium or coarse moist
rales, indicate by dots of
varying size or small circles.Sibilant — $\sqrt{\sqrt{\quad}}$ Sonorous — $\sqrt{\sqrt{\quad}}$

Friction sounds (pleuritic)

#

Voice Sounds

Vocal resonance dim. =

"Voice — (minus) or >
(dim.)"

Vocal resonance increased =

"Voice + or ++"

Bronchophony = "Br'y"

Tactile Fremitus = T. F.

Tactile Fremitus increased =
T. F. + or ++Tactile Fremitus decreased =
T. F. >Tactile Fremitus absent = T.
F. — (minus)**Percussion**

In percussion one should begin with the front of the chest and go from *below* upwards; for at the lower part of the chest one will generally get the normal resonance, and this can be taken as a standard with which to compare the resonance higher up. Comparatively light percussion is preferable in front and heavier behind. Sometimes both light and heavy percussion in front will better bring out differences in resonance if they exist. It must be borne in mind that at the right apex there is a physiological difference in the percussion sound from that at the left apex: it is not so resonant and of higher pitch, and, moreover, the respiration is rougher, or broncho-vesicular in character, and the voice sounds decidedly more intense. All this is

normal for the *right apex*. As Cabot says, "We find at the apex of the right lung in health signs almost exactly identical with those of a slight degree of consolidation." In early cases there is rarely any dullness. The most that we shall, as a rule, find is some slight diminution of resonance and a heightened pitch, changes so slight that it is difficult to be sure that they exist.

In making an early diagnosis, percussion will give us but little, if any, definite information. When unmistakable dullness is present, either an old arrested or inactive focus of consolidation of appreciable size exists, or, if active, the disease has passed beyond the initial stage. Sometimes when there is very considerable infiltration in both lungs, the percussion, although markedly impaired, may be so nearly the same on both sides, that one may not recognize that any dullness exists, particularly if there are no adventitious sounds. A mistake, and quite a natural one for a beginner, not infrequently made.

Auscultation

It is principally upon auscultation that one must depend for physical signs in early diagnosis, and here again such auscultatory signs will often be so indefinite that their interpretation becomes difficult if not impossible. Both in percussion and auscultation one can better discriminate between slight differences in pitch and sound if he has a musical ear. Hence the advantage of being able to sing or play upon some musical instrument or the train-

ing of one's ear in listening to good pure music. The elder Flint who was a consummate master of auscultation and percussion played the violin for years to "preserve the fine sense of pitch with which he was endowed." (Pryor.) Laennec, the inventor of mediate auscultation, played upon the flute, and Auenbrugger, the discoverer of percussion, was passionately devoted to music.

It does not make so much difference what kind of a stethoscope one uses, provided he becomes accustomed to it. It is very much like a sportsman who has become used to his own gun: it may have defects, but he has learned to make allowances for them, so that he can shoot more accurately with it than with a more perfect one with which he is not acquainted. So it is with the stethoscope which one constantly employs.

First, one studies the respiration; then the voice sounds, whispered and spoken, and finally seeks for adventitious sounds — rales. These latter, however, may be the first abnormality detected, and if localized and constant, they go far towards making a definite diagnosis, for they are *new* sounds, while modifications in the respiration are only variations of normal sounds and are of uncertain interpretation.

CHAPTER V

DIAGNOSIS, CONTINUED

The Respiration

In investigating the respiratory sounds one should first listen to quiet, ordinary breathing and then to deeper breathing, the mouth being slightly open; but no audible sound should be made in inspiration or expiration. It is often well to show the patient how you want him to breathe by doing it oneself.

The ability to distinguish abnormal respiratory sounds must depend upon a clear recognition of the normal vesicular murmur, and the advice given by the elder Dr. Bowditch nearly seventy-five years ago in his "Young Stethoscopist" is excellent advice now: "You cannot study too frequently," he says, "or too minutely the respiratory murmur and the voice in healthy persons. One of the best exercises you can have is the daily examination of three or four individuals who are free from thoracic symptoms. . . . For, in addition to having accurately learned the character of vesicular respiration, you will likewise have prepared yourself for the recognition of bronchial respiration and bronchophony when they are the result of disease."

One of the most significant modifications of the

respiratory murmur is what Turban calls "rough" breathing, which differs from the smooth sound of normal vesicular breathing in that it gives one the impression of air passing over a roughened surface, like riding in an automobile over a rough road in comparison with the easy rolling over a smooth one. At the same time, the respiratory murmur may be slightly diminished. Following the roughened inspiration, we may have a clearly discernible prolonged expiration, which may be more or less bronchial in character. This *rough* respiratory murmur is considered the earliest auscultatory manifestation of a tuberculous invasion, and is produced by slight inflammatory changes in the bronchioli.

Broncho-vesicular respiration is about the same thing as "rough" breathing considered from a different point of view. As the name implies, it is a mixture of the two kinds of murmurs, the bronchial element occurring in the expiration which is prolonged. This sign, says Flint who introduced the name broncho-vesicular in 1856, "represents the different degrees of consolidation of the lung between an amount so slight as to occasion only the smallest appreciable modification of the respiratory sound, and an amount so great as to approximate closely to the degree giving rise to bronchial respiration."

It is well to repeat, that what we may consider a "rough" or broncho-vesicular murmur at the *right* apex, unless much exaggerated, is physiological at that apex, and, as Cabot says, "we find in the apex

of the right lung in health signs almost exactly identical with those of a slight degree of solidification" and "would mean serious disease if heard over similar portions of the left lung."

I have often had students tell me, in the examination of a patient, that they found bronchial respiration in one place or another when it did not exist; and, in order to show them their mistake, I tell them to listen to normal bronchial breathing over the larger bronchial tubes, a little below the trachea in front, and at the level of the seventh cervical and the upper five or six dorsal vertebræ behind, and compare the respiratory sound heard here with their supposed bronchial breathing.

Genuine bronchial respiration is not, of course, an early sign. Sometimes one detects a definite difference in the intensity of the vesicular murmur in the two apices. In one apex it is distinctly less intense. We call it diminished or weak respiration; and when one is sure of the observation, it is a sign of considerable value in early diagnosis, and may be the only one we find.

Cog-wheeled or intermittent breathing in my experience is a sign of little value, for one so often hears it when there are no other symptoms or signs to indicate any pulmonary disease. At all events, when it occurs generally over the chest, it is of no importance; but when limited to one or both apices it may have some diagnostic value in combination with other signs.

After all is said, slight modifications of the

respiratory murmur are difficult of detection and of doubtful value. "Distinctions" (in the respiratory murmur), says Gee, "which correspond with no definite physical condition of lung, make a show of profound and accurate knowledge, but really obscure it. They are *idoli theatri*."

The Voice

In order to make the auscultation of the voice of value, it must be fairly resonant, and hence with some persons, especially women, when the voice is thin and feeble, the evidence obtained from this sign is of little worth. The patient is told to utter slowly some sonorous word. I find the simple "*one*" as good as any; others prefer "twenty-three" or "ninety-nine." It is to be borne in mind that normally the voice sounds are markedly louder at the right apex than at the left, and if one finds them of equal intensity at both apices, it is an indication that there is some infiltration at the left apex. The whispered voice is a more delicate test than the spoken one, and when it is of greater intensity and of a higher tone, it is indicative of some infiltration. In early cases, however, one will seldom be able to discern any appreciable difference, either in the spoken or whispered voice. Later, when there is definite consolidation, bronchophony appears over the consolidated area.

Tactile Fremitus

Unless there are gross changes in the lungs, the tactile fremitus, or vocal thrill, will not be altered. At best it is a sign of very secondary importance.

Rales

Rales are, by far, of the most significance of all the auscultatory signs, for they are definitely abnormal, and when persistent and localized, even if but a few and feeble, they have far greater weight in making an early diagnosis than any deviation in the respiratory murmur. Such rales as one hears in early cases are fine moist ones or "crackles," as some call them, generally heard only after cough. They are most commonly found above and below the clavicles, in the supra-spinous fossæ behind, and in the upper and middle interscapular region.

Although rales may not be theoretically considered the earliest physical sign of pulmonary tuberculosis, the great majority of physicians will make their diagnosis depend, so far as the physical signs are concerned, upon the discovery of rales, but they must be persistent and localized. In the examination of normal chests I have often found, on the first full inspiration, a rale or two, due to the sudden and unusual expansion of an atelectic lobule, but such rales disappear not to return after the first few full inspirations, and, therefore, they will not mislead one. One must never forget to have the patient cough and then take a full breath immediately thereafter, for thus rales will appear

which would otherwise not be detected. Turban mentions the incident of a patient who had consulted many doctors and who decided their diagnostic ability by whether or not they asked him to cough during examination.

One must agree with Hector MacKenzie that "the earliest physical sign which is *really* characteristic is the presence of rales," localized rales. They are unmistakable, and they are almost pathognomonic. No pains is too great in the endeavor to elicit them. "Not infrequently," says Dr. Bowditch, "a sound like a simple whistle or a sonorous rale is heard under the clavicle, while in the remainder of the chest there is a healthy vesicular murmur; this strongly indicates the existence of tubercular disease if the patient is suffering from a chronic affection, especially if it is connected with any other distinctly morbid physical or rational sign."

In making a physical examination one must not neglect the base of the lungs, for occasionally in adults and more frequently in children the first physical signs are discovered in the base of one or the other lung. With the adult, this means one of two things, either that the signs do not mean tuberculosis unless there is other corroborative evidence, or that there is also disease at the apex of the same lung which has not been discovered. If, however, we find evidence of basic affection and can find none at the top of the lower lobe, then the conclusion must be that the basic disease is not tubercular but

due to other causes, such as œdema, collapse, pleurisy, bronchitis, broncho-pneumonia, or, possibly, to actinomycosis or syphilis.

In doubtful cases one should go over the chest a second time, allowing the patient to rest between the two examinations. In this connection it is well to repeat again that in every suspected case an examination of the sputum should be made and several times repeated if the tubercle bacilli are not found upon the first examination. Although one can often be morally sure that tuberculosis exists from the symptoms and physical signs, yet absolute certainty can only be determined by finding tubercle bacilli in the sputum, for it is possible that the symptoms which we regard as indicating tuberculosis may be caused by other conditions. "Active disease confined to one apex," says Glover¹ "with a repeatedly negative sputum is not common."

After the most careful physical examination, one will often be unable to detect definite evidence of disease, if he bases his diagnosis upon physical signs alone; for as Knight, one of the most acute observers of our day, truly observes: "Variations in the respiratory murmur and slight modifications of the percussion note are not enough for a positive diagnosis," and "a patient should not be condemned to radical treatment upon such insufficient evidence." It is chiefly upon the symptoms that one must depend for an early diagnosis, unless he is fortunate enough to discover tubercle bacilli in the

¹ *Quarterly Journal of Medicine*, London, July 8, 1915, No. 32.

sputum or detects persistent localized rales, or hemoptysis has occurred not referable to any other source than the lungs. "Amidst the niceties of our physical examinations," says Dr. Bowditch, to whose wisdom I have before referred, "we are apt to neglect the rational signs. The truth is that he who scoffs at either must necessarily be a child in the diagnosis of not a few diseases; and he who cultivates both with the clear, keen-sighted eye of a true observer and then notes their mutual relations is the truly wise physician." If from all the evidence obtained one is unable to make a probable diagnosis sufficiently strong to warrant active treatment, he must keep his patient under observation and make repeated examinations at short intervals. Another point to remember is that the localization of the signs is quite as important, if not more so, than their character.

The following aphorisms of Lawrason Brown of Saranac Lake,¹ which are derived from a long and large experience, are most valuable guides. "For the beginner in work in pulmonary tuberculosis," says Brown, "succinct opinions in diagnosis are of great assistance."

I. "An appearance of ruddy health does not exclude tuberculosis."

II. "In any patient with constitutional symptoms, no matter of what he complains, the possibility of tuberculosis must be kept constantly in mind."

III. "Prolonged contact with tuberculosis may

¹ *Journal of the American Association*, June 12, 1915, Vol. 64, No. 24.

lead to infection, but debilitating conditions are necessary usually to cause this to develop into clinical tuberculosis."

IV. "Constitutional or general symptoms lead us to a diagnosis of tuberculosis, while the localizing symptoms point out the organs involved."

V. "Loss of color, prolonged exposure to tuberculous infection, especially in childhood, with a history of swollen glands at that time, the more recent subjection to debilitating conditions, the presence of unequivocal constitutional and localizing symptoms, with or without the aforementioned complications, demand a diagnosis of pulmonary tuberculosis even though no abnormal physical signs are present in the lungs."

VI. "*Your patients, your friends, your family* are as prone to contract and develop pulmonary tuberculosis as hundreds of others."

VII. "The importance of physical examination in the diagnosis of pulmonary tuberculosis has been over-emphasized."

VIII. "Symptoms are a better and more accurate guide to activity than physical signs."

IX. "Symptoms without physical signs demand treatment, while physical signs without symptoms require only careful watching."

X. "Slight but persistent rise in temperature, and increase in rapidity of pulse are often present early in the disease."

XI. "Failure to interpret rightly the significance of symptoms, to detect the presence of abnormal

physical signs can be condoned; but failure to ask for and examine the sputum repeatedly in any patient with chronic cough is inexcusable."

XII. "Absence of tubercle bacilli in the sputum means only that bronchial ulceration has not occurred."

XIII. "The usual weight of a patient who develops pulmonary tuberculosis is often ten pounds below the normal weight for his height and age."

XIV. "The detection of rales by the auscultation of the inspiration following cough is the most important procedure in the detection of physical signs of early pulmonary tuberculosis."

XV. "The disease is practically always more extensive than the physical signs indicate."

XVI. "Abnormal physical signs at one apex should be considered as due to pulmonary tuberculosis, until proved not to be, while those at the base should be looked on as non-tuberculous until definitely proved so."

XVII. "When sputum is lacking or when tubercle bacilli are absent on repeated examinations the possibility of the presence of bronchiectasis, hyperthyroidism, syphilis and influenza and more rarely pulmonary tumor and Hodgkin's disease should be borne in mind."

XVIII. "It may be impossible to determine definitely the presence or absence of clinical tuberculosis."

The X-Ray in Diagnosis

There are two other aids that may render a doubtful diagnosis certain: the X-ray and the tuberculin test. In order to be of much value the X-ray plate should be made by an expert technician who is also skilled in the interpretation of the roentgenogram or of the fluoroscopic picture. Moreover, one must be thoroughly familiar with the X-ray picture of the normal lungs. Under these circumstances the X-ray may "reveal and locate pathologic pulmonary changes to be detected by no other means" (Brown). It tells us nothing, however, as to the activity or non-activity of the lesion. Moreover, it often reveals more extensive disease than the physical signs show. If a tuberculous lesion is present the X-ray picture will indicate it by opacities, shading or mottling at the apex, or elsewhere, often difficult to detect and interpret. The X-ray is only an exceptional expedient when all other means fail; generally one can better spend his time in gaining perfection in diagnosis from the symptoms and physical signs, than in attempting to become skilled in the use of the X-ray or in the interpretation of its revelations.

The Tuberculin Test

This test, as generally employed, is of two forms: (a) the von Pirquet vaccination test, and (b) the subcutaneous one.

(a) The von Pirquet Test.

This test is chiefly useful with children under five years of age. It consists in slightly scratching the arm, after it has been cleaned with alcohol, with a sterilized needle or some sharp-pointed instrument, not deep enough, however, to draw blood. Three spots are thus scarified and upon two of them a drop of full strength old tuberculin (O. T.) is placed, while the third is left for a control. After ten minutes what remains of the tuberculin is wiped off and no dressing is applied. A reaction, if it occurs, will appear in from twenty-four to forty-eight hours, and will be indicated by a red raised areola at the site of the vaccination about the size of a penny, while the control spot will show nothing. As, according to von Pirquet, ninety per cent. of persons over fourteen years of age give a positive reaction, the test with adults is generally positive and only shows that there is a tuberculous lesion somewhere in the body, but tells us nothing as to its activity. A negative reaction in general indicates the absence of tuberculosis.

(b) The Subcutaneous Tuberculin Test:

In this test a minute amount of Koch's old tuberculin (O. T.) is employed, which can be prepared by diluting the original full strength tuberculin, or the dilutions can be obtained already made. So many tenths of a c.c. of the diluted tuberculin will contain the amount we wish to use. A syringe graduated in tenths of a c.c. is employed, and aseptic precautions, as with ordinary subcutaneous

injections, are, of course, taken. The injections are made preferably in the back below the angle of the scapula, although any other muscular portion of the body may be selected. The dose at first is one-fifth of a milligram, and if no reaction occurs, then one milligram and, finally, five to ten milligrams at three-day intervals. The patient must be afebrile, for a rise in temperature is one of the most important signs of a reaction.

The reaction is threefold: (a) local; (b) focal; (c) general; and it occurs in from four to thirty-six hours, the general reaction usually taking place in from four to twelve hours. The local reaction is indicated by redness and swelling at the site of the injection; the focal by signs of increased activity in the suspected focus of disease in the lungs, such as pain, increased cough and expectoration, and if rales were previously present, they are more evident. The general reaction consists of a rise of temperature from 100° to 102° F. or more; general malaise much like that from an attack of influenza, with headache, pain in the joints and back, anorexia, sweating, weakness and frequently nausea and vomiting. It is generally best to keep the patient in bed from twenty-four to forty-eight hours after the injection, although this cannot always be realized, and the test can be made with ambulatory patients, and they can be instructed to take their temperature at home.

The subcutaneous tuberculin test in the doses indicated above is without danger and can be safely

employed, and it is the most reliable of all the methods of using tuberculin for early diagnosis. It is to be remembered that a reaction only indicates that there is a tuberculous focus somewhere in the body; it does not tell us where it is or whether or not it is active and treatment is required. With other evidence, however, of active tuberculosis, it renders the diagnosis more certain, but does not make it positive. A failure to react, after a thorough trial, either gives us a probable assurance that no tuberculosis exists, or that the disease is so far advanced that the reactive forces of the body have lost their power. One of Brown's aphorisms is pertinent here; he says:

"No modification of the tuberculin tests as yet devised differentiates clearly clinical tuberculosis that demands vigorous treatment from non-clinical tuberculosis that requires only a God-fearing life."

The Stages of Tuberculosis

The following classification, essentially that adopted by the National Association, is generally employed in grouping the different stages of the disease.

I. *Incipient*: Slight infiltration limited to the apex or a small part of one lobe. Slight or no constitutional symptoms (particularly including gastritis or intestinal disturbances or rapid loss of weight). Slight or no elevation of temperature or acceleration of pulse at any time during the twenty-four hours; especially if at rest. Expector-

ation, usually small in amount or absent. Tubercle bacilli may be present or absent. No tuberculous complications.

II. *Moderately Advanced*: No marked impairment of function, either local or constitutional. Localized consolidation moderate in extent, with little or no evidence of destruction of tissue, or disseminated infiltration. No tuberculous complications.

III. *Far Advanced*: Marked impairment of functions, local and constitutional. Localized consolidation, intense or disseminated areas of softening, or serious tuberculous complications.

Such a classification is more or less unsatisfactory because in practice the extent of the physical signs in many cases does not agree with the symptoms of the stage to which the signs belong; for example, the physical signs may indicate a moderately advanced or a far advanced case, while there are only the symptoms of an incipient case. To remedy this, Dr. Rathburn of the Otisville Sanatorium, N. Y., has suggested the following classification of the physical signs and symptoms.

Physical Signs:

Stage I. Slight infiltration limited to the apex of one or both lungs or a small part of one lobe. No tuberculous complications.

Stage II. Localized consolidation, moderate in extent, with little or no evidence of cavity formation, or infiltration more than under incipient (Stage I). No serious tuberculous complications.

Stage III. Marked consolidation of an entire lobe, or disseminated area of beginning cavity formation; or serious complications.

Symptoms:

A. (Slight or none.) Slight or no constitutional symptoms (including particularly gastric or intestinal disturbance or rapid loss of weight.) Slight or no elevation of temperature or acceleration of pulse at any time during the twenty-four hours. Expectoration, usually small in amount, or absent. Tubercle bacilli may be present or absent.

B. (Moderate.) No marked impairment of function, either local or constitutional.

C. (Severe.) Marked impairment of function, local and constitutional.

Thus, for example, a patient with physical signs of a far-advanced lesion (Stage III), with no marked impairment of function, either local or constitutional, would be classified III B; or a moderately advanced case as to the physical signs (Stage II), with incipient symptoms would be classified as II A. In this way, one obtains an accurate idea of the extent of the lung involvement, and also of the toxæmic state of the patient.

Further Advanced Disease

When the disease has advanced beyond the early stage, the diagnosis, as a rule, is more readily made, — the symptoms are more evident, and the physical signs more definite: — toxæmic indications show themselves and rales are generally present.

Moderately Advanced Tuberculosis

In this stage there is more or less solidification, and, if slight, it may be difficult to recognize it, especially if at the right apex. The resonance will be impaired and the breathing will be rough, or broncho-vesicular. The voice sounds, also, will be intensified. There will often be some softening, indicated by rales of varying size and by the expectoration. Some of the unmistakable symptoms of tuberculosis, such as cough, weakness, loss of weight, rapid pulse and rise of temperature will generally be present.

More Advanced Tuberculosis

As softening proceeds, the character of the rales changes: they are more numerous, larger and more liquid. With the increase of the consolidation, the breath sounds approach the bronchial type, and bronchophony is present over the diseased area. When a cavity exists, it is not always easy to recognize it, and it does not make much difference if it is not detected, for the other evidence indicates the state of the case. "Practically," says Gee, "the physical diagnosis of excavation mostly comes to this: that in progressive phthisis a cavity is presumed to be present where the bronchial breathing is most intense." The signs usually relied upon for the diagnosis of a cavity are (a) amphoric or cavernous respiration; (b) cracked-pot resonance on percussion, and dullness; (c) coarse gurgling rales.

When contraction takes place after excavation,

the normal expansion of the diseased side is either markedly decreased or absent, there is woody dullness over the area and there may be complete absence of breath sounds; or, if the arm is raised, one generally hears cavernous respiration in the apex of the axilla. The cavity is generally dry and rales are absent. With the contraction, the heart is more or less displaced; if the contraction is in the upper left lobe, the heart may be displaced upwards; if in the right upper lobe, it may be displaced to the right. In the opposite lung, if not diseased, there is generally compensatory hypertrophy, with increased functional activity, indicated by rough breathing and prolonged expiration.

Mode of Advance of Pulmonary Tuberculosis

From the primary focus which, in the large majority of cases, is at the apex, the disease usually extends downward along the anterior aspect of the upper lobe. Next, the apex of the lower lobe of the same side is usually affected, often long before any extensive infiltration or softening has occurred in the upper lobe, and generally before the opposite lung is attacked. The bases are often but little affected and may not be at all. The spread of the disease in the opposite lung takes place in the same way. Fowler has observed that the earlier lesion does not occur at the actual summit of the apex, but one to one and one-half inches lower, corresponding in front with the middle of the clavicle. From this part the lesions spread at first chiefly

backward, so that the signs behind are more evident than those in front. Fowler also mentions that a favorite early spot for secondary infection is the middle of the interlobar septum, corresponding with a spot in the upper part of the axilla; hence, one should always carefully examine this region.

As the disease progresses, both sides, as a rule, become involved, but often not equally so. In the incipient stage one rarely finds both apices affected at the same time.

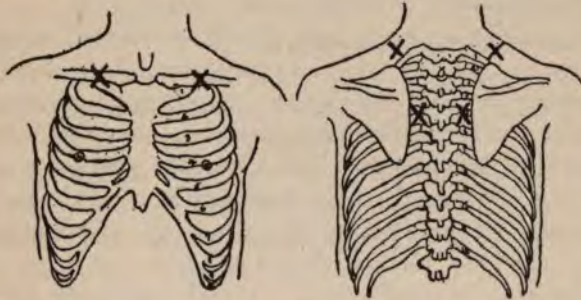


Fig. 11. Showing the common seat of the earliest tuberculous lesions (after Fowler)

Differential Diagnosis

(a) *Actinomycosis*:

There are other conditions and diseases which may be mistaken for tuberculosis, some rare and others more common. (a) *Actinomycosis* is one which may first manifest itself in the lungs. The physical signs, however, are usually basic while the

apices are clear. The occupation of the patient which causes him to deal with cereals; the presence of lesions elsewhere in the body; the pain; the absence of tubercle bacilli in the sputum or in the pus from an abscess, after repeated examinations and the detection of the ray-fungus will clear up the diagnosis. It is not a common disease, but it occurs, and I have mistaken it for tuberculosis. Of course, it may be associated with tuberculosis in the same individual.

(b) *Malignant Disease of the Lungs:*

This is also rare, and can hardly be mistaken. There is a history of pre-existing malignant disease in other parts of the body; marked rapid cachexia; severe persistent localized pain; absence of tubercle bacilli in the sputum. The physical signs are more likely to be found in the middle or base of the lung, and do not advance as in pulmonary tuberculosis. We may have bloody pleural effusion, but this may occur also in tuberculosis. If there is doubt as to the diagnosis, the X-ray will be of service.

(c) *Pulmonary Syphilis* is of still rarer occurrence, although the co-existence of syphilis and tuberculosis is not infrequent. From the physical signs one cannot differentiate pulmonary syphilis from pulmonary tuberculosis. The points which suggest the former disease are (a) more extensive physical signs than the symptoms would indicate; (b) the history of and evidence of syphilis elsewhere in the body; (c) the absence of tubercle bacilli; (d) laryngeal and pharyngeal lesions; (e) the effect of

anti-syphilitic treatment. When doubt exists a Wasserman test should be made.

(d) *Influenza:*

This infection often simulates very closely pulmonary tuberculosis. The constitutional symptoms and physical signs may be quite similar. The physical signs are more likely to be found at the base than at the apices of the lungs; still, we may have dullness, rales and modified breathing at the latter location. The sputum, which is purulent, does not contain tubercle bacilli, but does the influenza bacillus. In influenza the constitutional symptoms may not be so severe as the apparent extent and activity of the lung process would indicate, nor is the disease generally so chronic or progressive. Often a patient gives the history of a previous attack of influenza which may have been an active outbreak of a latent tuberculous focus, which latter again became inactive.

(e) *Malaria:*

Formerly the mistake was common of treating a case of tuberculosis for malaria from error in diagnosis. At the present time, a careful physical examination, together with that of the blood and sputum, and, if necessary, the therapeutic test of Quinin ought to clear up any doubt.

(f) *Bronchiectasis:*

The history, course and physical signs differ in this disease from those in pulmonary tuberculosis.

In bronchiectasis we have the history of a prolonged bronchitis with intermittent expectoration of a profuse, ill-smelling sputum in which tubercle bacilli are absent. Generally there is no pyrexia, and the constitutional symptoms are slight. The physical signs are generally at the base and suggestive of a cavity.

(g) *Bronchitis:*

Many a poor consumptive has been deluded by the diagnosis of "bronchitis" or "bronchial affection" because he had a lingering and severe cough, and lost his golden opportunity for treatment; and yet the differential diagnosis is not difficult. In bronchitis the physical signs are almost always bilateral and consist mainly of a variety of rales, especially bubbling and sibilant, similar on both sides, and more often confined to the bases of the lungs; there is no dullness and little if any change in the respiratory murmur. The constitutional symptoms are not commensurate with the extent of the disease as indicated by the rales; there is no such loss of weight or strength and the increased temperature does not persist; the sputum shows no tubercle bacilli. Nevertheless, one must bear in mind the fact that a bronchitis may mask an underlying tuberculous lesion and only continued observation and examination of the sputum, or an hemoptysis will clear up the doubt.

(h) *Neurasthenia:*

In this condition the effect has not infrequently

been taken for the cause. The debility, anæmia, loss of flesh, anorexia, digestive disturbances, and perhaps cough,—some or all of which may be present in the supposed case of neurasthenia, may be due to a tuberculous infection. In the former case, however, there is no pyrexia, no tubercle bacilli in the sputum, if there is any sputum, and no physical signs discoverable. In every case of supposed neurasthenia the possibility of tuberculosis should be kept in mind, and a thorough physical examination always made. In not a few instances one will have to suspend judgment and keep the patient under observation. Fortunately in both conditions the treatment is essentially the same.

(i) *Asthma*:

Asthmatic signs may mask a tuberculous lesion, and one can only wait for an opportune moment when such signs are absent to make a satisfactory examination. The history, examination of the sputum, and the general symptoms will generally lead one toward a correct diagnosis.

(j) *Pleurisy*:

Pleurisy is so often secondary to tuberculosis that a careful examination should always be made of the lungs to detect a primary tuberculous focus. We may find fine rales at the apex, but in case of pleurisy they are not lasting. If there is an effusion, and no other evidence of tuberculosis, animal inoculation may be necessary to determine the nature of the fluid.

(k) Cardiac Lesions:

The heart should always be examined when investigating the condition of the lungs; otherwise one may sometimes be deceived when hemoptysis and oedema are present, as in mitral lesions, especially stenosis.

Other Diseases and Conditions

Persistent anæmia, chlorosis, dyspepsia with loss of weight, a localized suppurative process, hyperthyroidism, and, rarely, Hodgkin's disease, present some of the ear-marks of pulmonary tuberculosis; but a careful investigation will differentiate them from the latter disease.

Three aphorisms of Gee may form a fitting close to this chapter upon diagnosis:

(a) "Almost every chronic affection of the apex of the lung is tubercular in origin."

(b) "Therapeutics must begin before physical signs have developed; if you wait for physical signs you wait too long."

(c) "In a young man an attack of hemoptysis is quite sufficient indication for treating him for pulmonary tuberculosis. It is not so in the case of a young woman."

CHAPTER VI

PROGNOSIS

"There is a history in all men's lives,"
"Figuring the nature of the times deceas'd."
"To which observ'd a man may prophesy,"
"With a near aim, of the main chance of things"
"As yet to come to life, which in the seeds"
"And weak beginnings lie entreasured."

Henry IV, Part II, Act III, Sc. 1.

When a definite diagnosis of pulmonary tuberculosis has been made, the patient naturally wants to know what are his chances of recovery, and although it is obviously impossible to give any positive opinion without the observation of the patient for a period of time, while he is under treatment, and gauge the response of his defensive forces; yet there are certain indications which the history and examination may have revealed, which will aid us in forming some estimate of the future course and result of the disease.

Definition of "Cure"

What is generally meant by a "cure" is not a "restitutio in integrum," as though the disease had never existed, but a permanent arrest of the infec-

tion and its local process, so that the individual is restored to his former life of activity; he is clinically, or, as some choose to call it, "economically" well. What is the probability of obtaining this desired result is the question to be answered.

In studying the individual case in reference to the prognosis, all the factors involved, past and present, should be considered, and no one factor should be regarded as of paramount importance; physical signs alone should not constitute the basis of the prognosis, for the symptoms are of equal if not greater importance. "The nature of the symptoms," says Lindsay, "probably give us the most trustworthy of all prognostic indications." To go beyond the present indications, the most reliable guide, as has been referred to above, is the reaction of the patient under treatment. After a sufficiently extended trial, if there is no response, the patient is doomed.

I once remarked to Walther, the head of a well-known sanatorium in Germany, that I supposed he only received early cases. "I take all kinds of cases," he replied. "I never can tell whether they will recover or not." There are early cases, so far as the physical signs are concerned, who develop no resistance and the disease pursues a steady downward course, do what we will; and, on the contrary, there are other more-advanced cases, who show remarkable response to treatment and eventually arrive at an enduring arrest. But few cases, then, should be pronounced absolutely hopeless.

General Propositions

The general propositions to be kept in view in giving a prognosis are well stated by Lindsay.¹

(1) "Whether there is a reasonable hope of complete recovery."

(2) "Whether the case is, upon the whole, favorable, a good rally probable and treatment likely to repay its cost in time and money."

(3) "Whether the case is, upon the whole, unfavorable, and admitting only a moderate degree of improvement."

(4) "Whether the case is definitely unfavorable and admitting only a slight degree of palliation."

(5) "Whether the case is obviously hopeless and systematic treatment useless."

It is self-evident and proved by experience that the earlier the disease is diagnosed and treatment instituted, the better the prognosis, and, on the contrary, the later the disease comes under treatment the more unfavorable the prognosis, but there are not a few exceptions.

Especial Indications

(a) Character of the onset:

The more acute the onset, as it were, an advanced case from the beginning, the less favorable is the prognosis, while an insidious onset is of no definite prognostic significance.

(b) The rate of progress in relation to the duration of the symptoms:

¹ "Diseases of the Lungs." N. Y. 1904.

If the disease has existed but a short time and yet there is evidence of rapid extension and destruction of lung tissue, or both lungs are involved at an early period, the prognosis is unfavorable.

(c) The character of the constitutional symptoms:

If these are marked, such as persistent high temperature, rapid pulse (either with or without fever), progressive loss of weight and strength, anorexia and digestive disturbances, the prognosis is unfavorable, while, on the contrary, absence of pyrexia, a gain in weight, diminished cough and expectoration are favorable signs.

(d) Increase of moisture in the diseased portion, as indicated by the increase and size of moist rales is unfavorable, even if there is general improvement.

(e) Any serious complication, either tuberculous or non-tuberculous, such as diabetes, albuminuria, syphilis, laryngeal tuberculosis, chronic diarrhoea, peritoneal or intestinal tuberculosis, render the prognosis more unfavorable. Pregnancy has generally been considered an unfavorable complication, but it is not invariably so; much depends upon the stage and activity of the disease at the commencement of the pregnancy. Occasionally actual improvement has taken place as a result of the condition. As a rule, however, pregnancy, in an active state of the disease, must be regarded as of unfavorable prognostic significance. Fistula-in-ano does not materially affect the prognosis, nor does an in-

tercurrent pleurisy; if there is effusion, whether removed by absorption or aspiration, the favorable course of the disease may go on thereafter uninterruptedly. Various acute diseases occurring shortly before the advent of the tuberculosis, render the prognosis rather more unfavorable, such as influenza, pneumonia, typhoid fever, bronchitis, and whooping cough and measles in children. They lower the resistance of the patient to the new tuberculous infection. When the constitutional symptoms are marked and out of proportion to the physical signs indicating the virulence of the infection and ascendancy of the toxæmia, the outlook is unfavorable unless resistance can be promptly developed by treatment; and when the physical signs and symptoms are at variance the symptoms are a safer prognostic guide than the physical signs.

Bearing of the Previous Life and Habits upon the Prognosis

If the patient has lived a regular life under good hygienic conditions as to food, fresh air and rest, and yet develops pulmonary tuberculosis, the prognosis is less favorable in his case than that of one who has lived and worked under unwholesome hygienic conditions and been subjected to deprivations of one kind or another, for the treatment in the latter case is a more radical change in his mode of life than in the former case and may be expected to elicit a more ready and marked response. In the one case the unhygienic conditions of living may

justly be regarded as the exciting cause of the tuberculosis, while in the other we can only refer the development of the disease to an inherent lack of resistance.

Family Predisposition

How much importance should be attributed to the family history in estimating the prognosis it is difficult to say; in general, a rather more guarded prognosis should be given in the case of a patient with a tuberculous family history. That families vary in resistance to infection is a familiar fact; but that a specific lack of resistance to the tubercle bacillus exists in those of a tuberculous family history is questionable; a weak constitution, however, may be inherited which renders one more susceptible to any infection. Tuberculosis in one's immediate family may indicate a family predisposition to the disease or merely greater opportunities for contracting it.

The Temperament

Again, the temperament of the patient has a bearing upon the prognosis: We have the nervous type, represented by a person who is easily fatigued, has an indifferent appetite and poor digestion, and who sleeps but poorly; or the lymphatic type, which feebly responds to treatment, and in which loss of strength and a general depressed condition are the prominent symptoms. The physical signs may be slight and the symptoms subacute, and the patient may look pretty well; but with this type, as with the

preceding one, the prognosis must be guarded. On the other hand, there is the thin, sinewy type, with much endurance, a good appetite and digestion and a strong heart,—a type in which the local lesion is limited and tends to fibrosis rather than softening; and the hemorrhagic type in which small recurring hemorrhages occur, without effect upon the general condition, and in which the physical signs are insignificant. Both of these types offer a very fair chance of recovery.

Character and Intelligence of the Patient

A patient of determination and intelligence, who thoroughly grasps the situation, and is resolved to faithfully and persistently carry out the treatment and co-operate with his physician, obviously offers a better prognosis than one accustomed to self-indulgence, who has always had his own way, and who will not submit to the rigorous training involved in the treatment. As some one has facetiously, but with a good deal of truth said, "It depends more upon what is above the collar than what is below, whether or not one recovers." Ignorance and an inability to comprehend the situation and intelligently follow the indications, render the prognosis far less favorable: "It is impossible to cure a fool."

Age and Sex

As a rule, the very young and the old do badly, while the prognosis is best in early adult life. As

to sex, the prognosis seems to be rather more favorable in the male sex; but this may be due merely to the different habits and mode of life of the two sexes.

Various Other Conditions

The occupation; social status; financial ability to obtain the proper treatment; the habits, particularly as to the use of alcohol, or other excesses, are all obvious points to be considered in the prognosis.

Food

A most vital indication with regard to the prognosis, while the patient is under treatment, is the matter of the ingestion and digestion of food. If he can eat and digest the requisite amount of food and be nourished by it, it is an exceedingly favorable prognostic omen. If, as Napoleon said, "an army marches upon its belly," so a consumptive fights his disease with his stomach. "A consumptive who cannot eat is doomed."

Final Summary

In estimating the probable outcome in any individual case, the final judgment must be based upon the resistance of the patient to the bacilli and their toxins. The result depends upon the issue of the conflict between these two opposing forces, and only after a period of observation of the contest can we form a reasonable opinion as to the ultimate result.

Let us marshal the two opposing forces. The activity of the infecting forces, which means vic-

tory for them, is indicated by the following symptoms and signs:

- (a) Rapid and low tension pulse.
- (b) Fever.
- (c) Steady and rapid loss of weight.
- (d) Anorexia and digestive disturbances.
- (e) Loss of strength.
- (f) Marked dyspnœa.

And with reference to the local process, evident extension and softening, with numerous tubercle bacilli and a variety of rales.

On the side of the resistance, as indicating victory, we have:

- (a) No fever.
- (b) Quiet pulse and nervous system.
- (c) Weight not diminished or increasing.
- (d) Good appetite and digestion.
- (e) Strength not materially lessened.

And the local process limited and not advancing.

It is well again to repeat that the physical signs may be very slight and yet the constitutional symptoms marked, indicating that the toxæmia has overcome the resistance; or, on the other hand, we may have extensive physical signs with few or no constitutional symptoms, indicating that at least an equilibrium or stalemate, more or less permanent, exists between the opposing forces.

Scheme of Results

The scheme of results adopted by the National Association for the Study and Prevention of Tuber-

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culosis and the American Sanatorium Association in 1913 is as follows:

I. Apparently cured: All constitutional symptoms and expectoration with bacilli absent for a period of two years under ordinary conditions of life.

II. Arrested: All constitutional symptoms and expectoration with bacilli absent for a period of six months, the physical signs to be those of a healed lesion.

III. Apparently arrested: Same as above, except for a period of three months.

IV. Quiescent: Absence of all constitutional symptoms; expectoration with bacilli may or may not be present; physical signs stationary or retrogressive; the foregoing condition to have existed at least two months.

V. Improved: Constitutional symptoms lessened or entirely absent; physical signs improved or unchanged; cough and expectoration with bacilli usually present.

VI. Unimproved: All essential symptoms and signs unabated or increased.

CHAPTER VII

TREATMENT

"I cannot help believing that medical curative treatment will resolve itself in great measure into modifications of the food swallowed, and breathed, and of the natural stimuli, and that less will be expected from specifics and noxious disturbing agents."

O. W. Holmes, 1861.

Cases Requiring No Treatment

In the first place, one should bear in mind that pulmonary tuberculosis which has been diagnosed by the physical signs alone, and is without symptoms, requires no treatment. Symptoms are the indication of active disease, and for active treatment. This point needs to be emphasized, for it has happened that individuals have been condemned to unnecessary treatment, their accustomed life disarranged, and their domestic economy upset, solely upon the ground that physical signs were discovered.

The Patient Should Be Told His Condition

At the outset the patient should be told, in a kindly and tactful way, his condition, and the hopeful outlook in his case, supposing it is a curable

one, if he conscientiously follows out the treatment and co-operates with his physician. It should be impressed upon him that disaster is likely to follow if he neglects or defers the proper treatment. The same should, likewise, be said to his family or friends. The treatment is then explained in detail, and the plan for the individual case arranged, whether the treatment is taken in or out of a sanatorium.

Principles of the Treatment

Like the snakes in Ireland, there is no remedy for pulmonary tuberculosis in the sense of a specific medicine or form of treatment directly applied to the exciting cause,—the tubercle bacillus. Innumerable supposed specifics have been proposed and tested, but all have been found wanting. The only treatment which has successfully stood the test of time and experience is the indirect one of developing and maintaining the resistance of the individual to the toxæmia of the infection. We name it the “hygienic-dietetic,” or “open-air” treatment. In brief, it consists (a) in breathing pure out-door air night and day; (b) an abundance of nourishing food; (c) rest in the open air, all the time if the patient is febrile, and at least a portion of the time if afebrile; (d) proper disposal of the sputum to avoid reinfection; (e) combatting all symptoms or conditions which interfere with the main treatment.

Whether the treatment should be conducted in a

sanatorium, at one's home, or elsewhere in an open resort, must be decided by individual conditions, such as the domestic and pecuniary circumstances, the character, temperament, age, and the opportunity of securing competent medical supervision. With some patients of weak will, and in an indulgent family, it would be well nigh hopeless to prosecute the treatment with success at home. Although the essentials of the treatment are simple and few, they must be rigorously adhered to, and the patient must be where this can be done.

Sanatorium or Outside Treatment

On the other hand, one should not off-hand advise the sanatorium for every case, for not every patient, for one reason or another, is suitable for institutional treatment, and some will not go and others cannot. For the majority of patients, however, a good sanatorium probably offers the best chances. If the physician and patient decide upon the sanatorium, they should be assured that its equipment, management, and medical direction are satisfactory; and of especial importance is the character and skill of the physician in charge. Excellent results have been and can be obtained in an open resort, like Saranac Lake or Asheville, or at one's home, if the services of a skilled physician are at hand; for the constant supervision of a competent physician is one of the prime essentials of the treatment.



Fig. 12. Inexpensive sleeping balcony in a country house



Fig. 13. Sleeping tent on roof (case in Boston)

℞	Dionin	grs. v (0.32)
	Aquæ amygd. amar	℥iss (45.0)
	Aquæ ad	℥iii (90.)
℥	Sig.	℥i t.i.d.

Or dionin $\frac{1}{4}$ gr. tablets, or heroin $\frac{1}{24}$ to $\frac{1}{12}$ gr. tablets. These should be discontinued, of course, on the amelioration of the cough. If the temperature is not above 99° , rest should be enjoined but not necessarily bed rest.

The Out-Door Life

The first requisite in the treatment is the provision for the out-door life, both by day and night. Some kind of a sleeping porch can generally be devised, a piazza utilized, or a tent or simple structure in the yard or on the house top, arranged for the out-door sleeping.¹ (Figs. 12-18.)

Occasionally it will be found that one cannot sleep well out of doors; he is nervous, and is unable to keep comfortably warm. Under these circumstances, a well ventilated room with open windows is preferable. In the colder months of the year one should wear warm night clothes with woolen socks and have sufficient light bed covering, or a sleeping bag, and, if needed, a heater for the feet. A simple device for preventing the heat of the body from escaping below, and keeping out the

(¹ The reader is referred to "Fresh Air and how to use It" by Carrington, published by the National Association for the Study and Prevention of Tuberculosis, 1912, for many valuable suggestions and illustrations with reference to out-door sleeping.)

wind, is several layers of newspaper placed under the mattress, or between two mattresses. If a piazza is used for out-door sleeping, some protection from the wind should be afforded. One should dress and undress in a warm room. If the morning light awakens one too early, a shield for the eyes can be used, and about as good as anything for this purpose is a long black stocking loosely tied over the eyes. The habit of out-door sleeping is soon formed, and the sleep is so much more refreshing that one rarely desires to return to in-door conditions. With febrile cases, where one is in bed all the time, either the out-door sleeping porch or a well-ventilated room with open windows can be employed, preferably the former.

By day, during the rest periods, one can sit on the piazza, in the yard or on the house top, wherever the air is free and there is sunshine. During the cold weather, he must be well protected, both as to inner and outer clothing. A fur coat is the best outer covering; and woolen stockings, with high arctics, felt shoes, or sheepskin moccasins will keep the feet warm. A reclining chair, such as a ship's deck chair, is preferable; or, if an ordinary chair is used, a common soap box into which the feet are placed will protect them from the wind and cold. When very cold, a knitted hood can be worn on the head and fur gloves on the hands. Thus protected, one can defy almost any temperature.

While at rest out-of-doors one can either do nothing or occupy himself with some light handiwork,



Fig. 14. Sleeping porch (Carrington)

such as knitting, basket-making, light wood-work, simple games or reading. The effect of the constant open-air life is often very striking: the appetite and digestion are stimulated, weight is gained, sleep is sounder and more refreshing, nervous irritability disappears, and there is a general sense of well-being.

The Food

The nourishment of the patient should receive the most careful attention, and should be adapted to each individual case. If the appetite and digestion are normal and the patient is not much under weight, three liberal meals a day with the addition of milk will generally be sufficient. A mixed diet, as in health, is the desirable one, consisting of the proper proportions of proteids, carbohydrates and fats: of the proteids, from 500 to 700 calories; of the carbohydrates, 1200 to 1500 calories; and of the fats, 1300 to 1500 calories. If an increase in the amount of fats is indicated, these can be given in the form of butter, cream, olive oil, and other animal and vegetable fats.

The food should be varied, well cooked, and served, so as to be attractive and appetizing, and it should be taken at regular times. If the patient is much under weight or cannot eat a full meal, supplementary meals or simple lunches can be taken between the regular meals, consisting of milk and eggs, bread and butter, broths, cocoa, or other simple nutritious nourishment. If milk in its natural state is distasteful or causes digestive dis-

turbances, it can be modified in various ways: some alkali, as lime water, Apollinaris, or Vichy water may be added; it can be peptonized, or mixed with the malted milk preparations, or taken in the form of kumiss, buttermilk, gruel, junkets, whey, etc.

Very often it will be found that more or less anorexia and digestive disturbances exist, in which event special dietaries will have to be arranged and the appropriate means taken to correct the dyspeptic symptoms. Constipation is one of the most common complaints, and it should be relieved, if possible, by means of the diet: stewed prunes, made more laxative by cooking them with senna leaves; stewed onions, rhubarb, laxative fruits and vegetables, cream or more fat of other kinds are useful for this purpose. A glass of warm water before meals is another expedient. If these measures do not avail, some of the simpler laxatives may be employed, such as the purified liquid petroleum, cascara sagrada, or one of the laxative waters or salts. Sometimes special diets or food preparations may be required for a while, but every effort should be made to return to the ordinary mixed diet as soon as possible.

The physician cannot be too painstaking in supervising the diet of the consumptive patient as to quality, quantity, the proportions of the food constituents, proteids, carbohydrates and fats, and the preparation, for "the consumptive who does not eat is a consumptive lost." No perfection of the open-air treatment will avail unless the patient is



Figs. 15, 16. Simple sleeping porches (Carrington)



well nourished. Rest before and after meals, especially the noon meal, should be the rule. The teeth must be kept in order and clean, for "well masticated is half digested." Before meals the mouth should be cleaned with some mild antiseptic solution, and after meals the teeth should be brushed.

Suggestive Articles of Diet

(All food must be properly cooked and well served)

The following suggestive articles of diet will be a useful guide:

Beef (rare) roast; steak; mutton (roast), chops; fowl; bacon; good sausages; minced meat; cold meat and fowl; sweetbreads; eggs (raw, poached, boiled). Vegetables, such as, baked potatoes, peas, string beans, spinach, asparagus, etc. Fish; soup (thin at dinner). Bread and butter, rolls, corn meal bread, rye bread. Cream or milk toast; cereals with cream and sugar. Soft boiled rice with cream. Farinacious puddings; ice-cream. Cheese. Salads, with oil dressing; sauces in which butter is the principal ingredient. Fruit, raw or cooked, as baked apples, stewed prunes, marmalade. Oatmeal gruel. Coffee (moderate), tea, cocoa, milk. (A glass or more of milk at each meal, and between meals, if ordered.) Good water plentifully taken at and between meals.

Exercise

All febrile patients, as has been said, must be kept absolutely at rest, and all afebrile patients must

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have periods of rest, especially when the vitality is low and the patient is under weight. There comes a time, however, when some exercise is allowable and beneficial; but it must be prescribed by the physician as to the kind and amount, and carefully supervised. The condition which permits exercise is that in which the patient is free from fever and constitutional symptoms; when the active stage of the disease has passed and he is on the road to an "arrest." The supreme test that exercise is beneficial and not harmful is the absence of any rise of temperature or increase of pulse rate a half hour or an hour after the exercise, and of any constitutional disturbance, such as headache, lasting fatigue and a general feeling of weakness and malaise. When these symptoms occur, all exercise should be intermitted for several days. Walking is the best form of exercise to begin with, taken on the level at first, and, later, on very gradual ascents. The length of the walk must be definitely determined by the physician. Various other forms of exercise or work, such as can be gradually increased from a little and light to a longer period and more severe, can be engaged in. To ensure success and avoid mishap, all work should be carefully graded, going on from step to step. The patient's condition, tastes and circumstances will often suggest the especial form of exercise. It may be some useful employment, such as light farm work, gardening, book-binding, or a limited amount of house work for women.



Fig. 17. The Dunham bed, showing how head may project out of window



Fig. 18. The Millet Sanatorium at East Bridgewater. Shack used for treatment of tuberculosis

In determining the time to begin exercise in the course of the treatment, each individual case must be considered by itself. In general, we can say that exercise is beneficial at that stage of the disease when the strength and weight have increased, and there is no fever or other symptoms indicating toxæmic activity. The proof of benefit from the exercise is continued improvement in the general condition. When the proper time comes for exercise, it should be begun as an integral part of the treatment, for when the recovery is achieved, the patient should be ready to again take his place in life's activities.

Violent forms of exercise, such as horseback riding, tennis, dancing and rowing are unsafe. Golf, however, is allowable, and it has the advantage of being easily graded, as one can be given only a certain number of holes to play. Gymnastic and breathing exercises are of doubtful value and may do harm, and it is safer not to employ them. If there is doubt regarding the question of exercise, it is well to remember that no harm can be done by rest, but that "more consumptives kill themselves by taking too much exercise than in any other way."

Clothing

Little need be said upon this subject. Such clothing should be worn as will make the patient comfortable and no more. The clothing should be evenly distributed over the body, and no greater thickness, such as chest protectors, vests or sweat-

ers, should be worn over the chest than elsewhere. Too heavy clothing only overburdens one and causes him to perspire more easily; generally, however, the patient is rather more susceptible to cold and needs to dress a little warmer than in health. Light woolen or merino underclothing is advisable and should be loose enough to permit a circulation of air beneath it. The undergarments worn during the day should be removed at night and thoroughly aired, and they should also be changed if one gets overheated and perspires. For out-door use in winter a fur coat is the warmest.

The Cold Bath

A warm soap bath for cleanliness should be taken once or twice a week and in addition a cold sponge or shower bath in the morning on getting up if a speedy reaction occurs thereafter. If, on the contrary, there is a failure to react, as indicated by chilliness, lasting a considerable time, after the bath, blueness, "goose-flesh," and a feeling of depression instead of one of invigoration, the bath should be abandoned or milder hydrotherapeutic measures employed until one is able to endure the more rigorous form. The cold bath is a hardening process, its object being to stimulate the peripheral nerves, increase the appetite, improve nutrition and assimilation, and to produce an invigorating effect on the body as a whole. The temperature of the water should be from 70° to 60° F. or even 55°. Simple means can easily be obtained for taking the cold

bath. All that is really requisite is a tub of some kind, a large sponge and a coarse towel. Salt may be added to the water to increase its stimulating effect. One saturates the sponge with water, and squeezes out the whole amount in a shower down the back and front, as he stands in the tub; this procedure is rapidly repeated over all parts of the body for about half a minute; he then rubs himself dry with the coarse towel. Instead of the sponge, a pitcher of water can be poured over the body, or a hose with a spray attachment can be connected with any convenient faucet in the house.

With some patients, one has to begin gradually and work up to the cold bath: at first, with dry rubbing morning and night; later, with moist rubbing by means of a wet, coarse cloth or by enveloping the patient in a wet sheet and rubbing him over it, until, finally, the stage of the ordinary cold bath is reached. If there is a tendency to hemorrhage, there is danger in the cold bath and it should be omitted.

The Psychology of the Patient

It is obvious that tranquillity of mind and contentment are essential in order to realize the best results from the treatment. "The consumptive must be treated in *toto*," says Dettweiler, "and his moral and mental education is quite as important as his bodily treatment." To secure this, much depends upon the personality of the physician; he must be able to inspire his patient with hope and courage. Everything which has a tendency to produce nerv-

ous and mental excitement, such as domestic or financial worry, or exciting literature, should be sedulously avoided. Some simple, soothing diversion is often of assistance in distracting the patient's thoughts from his malady. Such are games of solitaire, simple, light occupations, like knitting, raffia work and the like, or an amusing story. Music is one of the best means of soothing and diverting the patient. I recall a visit to a German sanatorium where one of the features was a band concert several times a week.

"When griping grief the heart doth wound,
And doleful dumps the mind oppress,
Then music with her silver sound,
With speedy help doth lend redress."

Often a talk with the physician will relieve a depressed patient and inspire him again with hope. A firm religious faith is a precious asset, yielding that peace of mind and restfulness of spirit which "passeth understanding."

Personal Hygiene

The consumptive must maintain absolute cleanliness. The hands should be washed before each meal, the mouth cleansed, and the nails kept well manicured. The sputum should never be swallowed, and none should be allowed to soil his body or bed clothes or anything he handles. When coughing, one should hold something before the mouth. Any carelessness in disposing of the sputum may cause a reinfection or the infection of

some one else. If a mustache or beard is worn — which is not advised — this should be washed several times daily. In brief, everything on and about the patient, or used by him, should be kept scrupulously clean.

Osler's Summing Up

Osler thus succinctly and admirably expresses the sum and substance of the treatment:

"First: The confidence of the patient; since confidence breeds hope."

"Second: A masterful arrangement on the part of the doctor."

"Third: Persistence. Benefit is usually a matter of months; complete arrest a matter of years."

"Fourth: Sunshine by day; fresh air night and day."

"Fifth: Rest while there is fever."

"Sixth: Breadstuffs and milk, meat and eggs."

The following is an illustrative daily plan of life for an afebrile patient of fair resistance and with few if any constitutional symptoms:

7 A. M. Arise; a cold sponge or shower bath. Dress in a warm room.

7.30 or 8 A. M. Breakfast, and afterwards rest in a reclining chair, or a walk or other exercise if prescribed.

11 A. M. A light lunch, if ordered, consisting of a glass of milk and egg, or some simple articles of food.

12 M. to 1 P. M. Rest.

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1 to 1.30 P. M. Dinner.

1.30 or 2 P. M. Rest for an hour; later, a walk or other exercise.

4 P. M. A light lunch if ordered.

4 to 6 P. M. Rest or exercise as prescribed, but a half hour's rest before the evening meal.

6 P. M. Supper.

6.30 to 9 P. M. Simple recreation of some kind or rest.

9 P. M. Retire.

Of course the daily routine must obviously be arranged according to the special conditions of each individual.

"Suggestions and Aids"

I have been accustomed to hand the following brief suggestions to my patients, based largely upon similar ones devised by Dr. Minor of Asheville:

(These suggestions are general and not intended to take the place of the physician's advice for your special condition.)

"The labor which best repays a sick man is to get well."

If treatment is begun early most cases of tuberculosis can be cured, but it requires determination, perseverance, and often self-denial to accomplish it.

There are four (4) essentials in the treatment: (1) Competent medical guidance; (2) fresh air; (3) good food; (4) rest. There are no known medicines or specifics which will cure tuberculosis, therefore, do not take any drugs except what may

be ordered by your physician for certain special symptoms.

Whether the treatment in your case can be best carried out in a sanatorium, at home, or by going to a health resort, must be decided by your physician.

Most patients must devote their entire time to getting well, at least in the beginning of the treatment, for it requires constant attention to learn and become accustomed to the new method of living, which we call the "open-air" treatment, or the "cure."

Rest

Rest is very important in the "cure," and, if there is fever — a temperature of 99.5° or over — it should be absolute, and you should recline on a cot or reclining chair out-of-doors, or in bed with windows wide open. Even if there is no fever, you should spend a good deal of time at rest, especially at the beginning of the treatment. You can do this by sitting or reclining on a piazza or wherever fresh air can be obtained and protection from the wind secured.

The Outdoor Life

After the habit has been formed you should spend from seven to ten hours out-of-doors daily, winter and summer. When it is cold, dress warmly and use sufficient wraps to be *comfortable*. Keep in the sun, but protect the head from it. The outdoor life can be continued at night by sleeping out-

of-doors, either on a piazza, in a sleeping porch, or by using a window tent. Night air is as good as day air, and sometimes better. In sleeping out-of-doors, you must have sufficient covering and warm night clothes, a flannel nightdress, or pajamas, woolen stockings, a Jersey or "sweater," a woolen hood or helmet, and a hot water bottle or soap stone, if necessary to keep warm. If you sleep in a room, have a large one with two or more windows, facing South, Southwest, or Southeast, and if possible, with an open fireplace in it. When in the room and not in bed have the temperature from 65 to 68, unless dressed as for out-of-doors. Dress and undress in a warm place. Sleep alone, and if possible occupy the room alone. Have the room plainly furnished with few things in it, so that it can be easily cleaned and kept clean. Go to bed early, at 9 or 9.30 P. M.

Clothing

Wear such clothing as will keep you warm, but not such as will be a burden to carry about and cause you to perspire at any little exertion. Wear wool or merino next to the skin. Do not wear "chest protectors." Woolen stockings and low shoes will often keep the feet warmer than cotton stockings and boots. For outdoor use an ulster or fur coat is very serviceable. If you get overheated and perspire change the clothes and rub the skin dry. Never be chilly.

Bathing

Take a warm bath once or twice a week at *bed-time*. A cold sponge bath on getting up in the morning, as ordered by the physician. If you do not react, or feel chilly after the cold bath, or feel sick in any way, stop the bath and consult your physician. Take the cold bath in a warm room. If you have night sweats take a rub with vinegar and water at night, and a glass of hot milk. If you are frequently chilly, take an alcohol rub.

Food

If the digestion is good, eat three good meals a day, consisting of soup, meat, vegetables, bread and butter, milk, cream, eggs, articles of food containing fat or prepared with fat or oil, fruit, etc. Your physician may also order in addition to the three meals simple lunches at 11, 4 and bed-time, consisting of milk, raw eggs, bread and butter, cocoa, chocolate, soup, etc. Do not eat cake or pastry. Rest an hour before and be quiet an hour after meals. Eat slowly and chew the food thoroughly, therefore, see that your teeth are in good condition. Drink the milk slowly or sip it. If you think you are overeating from any feeling of distress after meals, or from any indication of indigestion, consult your physician. The food must be abundant, nourishing, and prepared in an appetizing manner. Your salvation lies in food, properly prepared, and in a stomach capable of digesting the food. Be regular at your meals and try to enjoy them. Eat

with others, and converse with others, rather than eat alone. Have your physician prepare a bill-of-fare for you. Drink pure water, and never take alcoholic stimulants unless prescribed by your physician.

Cough and Expectoration

Never spit anywhere except in a cuspidor with water or a disinfectant in it, or in a spit-cup, pocket spitoon, or a paper napkin which then can be put in a paper bag and burned. The best way of destroying the sputum is to burn it. In coughing, hold a cloth or paper napkin before the mouth; if a handkerchief is used, do not let it get dry, and wash it in boiling water. Ineffective coughing — that which does not bring up sputum — is useless, tiresome, and renders one conspicuous. Therefore, try to control and repress such a cough, which you can do by practice. Never swallow the expectoration, as it may cause further infection. Always wash your hands before eating; clean your teeth, and wash out your mouth and nose several times a day. If any expectoration should, by accident, get on the floor, or on any article of clothing or furniture, it should be wiped up at once with soap and hot water, or with a five per cent. solution of carbolic acid. Whatever increases the cough, refrain from doing. A *clean* consumptive is a safe consumptive.

Exercise

In your own special case, follow the advice of your physician; in general, at the beginning of the

treatment, it is usually best to keep pretty quiet. Never exercise if there is fever, if the temperature is over 99.5°. Never to the point of fatigue. No exercise for an hour after meals, and none if the sputum is streaked with blood. No gymnastic or breathing exercise unless ordered by your physician. Walking is usually the best and safest exercise, at least until the "cure" is well advanced. No violent exercise or such as causes you to feel uncomfortably short of breath.

Maxims and Random Hints

When in doubt about anything, consult your physician; take no chances.

Do not talk over your case with any one but the doctor.

A hemorrhage (spitting blood) is generally not a very serious symptom; if you have one, go to bed and keep very quiet and send for your physician.

It takes time to make the "cure," so do not be impatient to get well; a good cure is often a slow cure.

The instructions given you by your physician should be followed out in every particular.

A person suffering from tuberculosis is not dangerous to live with if he promptly destroys the sputum and covers his mouth when coughing.

A hopeful, cheerful disposition is one of the best remedies for pulmonary tuberculosis.

Your most important duty is to get well. Let all other duties be secondary.

"Whatever thou takest in hand remember the end, and thou shalt never do amiss."

"Whatever is worth doing is worth doing well."

"Where sunlight enters not, there the physician goes."

"It is part of the cure to wish to be cured."

The important essentials in the treatment of your disease are: Out-of-door life, winter and summer, day and night. Have no fear of night air, and none of draughts, provided you are properly protected. Avoid damp houses or rooms, and crowds, smoke and dust. Avoid all excesses. Eat plenty of good, nourishing food. Drink plenty of good water, but no alcohol. Be careful not to exercise when you should rest. Take no drugs except on the advice of your physician. Keep the body clean. Never swallow the sputum. Be hopeful and cheerful.

Special Directions of the Physician

Take your temperature at
 Lunches at
 Consisting of
 Hours out-of-doors
 Exercise
 Bathing

Day's Plan to be Filled Out by Your Physician

7 or 7.30 A. M.
 7.30 or 8 A. M.
 8.30 to 11 A. M.
 11 A. M.

11.30 A. M. to 1 P. M.	
1 to 2 P. M.	
2 to 4 P. M.	
4 P. M.	
4.30 to 6 P. M.	
6 to 7 P. M.	
7 to 9 or 9.30 P. M.	
9 or 9.30 P. M.	
Medicine, if any.	

Treatment of Advanced, Hopeless Cases

The main thing to be done for these deplorable cases is to make them physically comfortable, and everything which conduces to this should be allowed. Fresh air, they should have; but unless they desire it, they should not be exposed to the rigors of outdoor life in the colder season of the year. A comfortable bed in a well ventilated room is generally preferable. All the innumerable symptoms constantly complained of or imagined should be met with kindly attention and patience. If pleuritic effusion occurs, as it not infrequently does, it is not to be aspirated unless there is immediate danger of a fatal result, or it causes great distress. Sometimes the effusion renders the patient more comfortable or tends to retard the disease on the same principle as artificial pneumothorax. If the cough is harassing and prevents sleep, codein, heroin or dionin may be used, or sometimes the mild tincture of opium (tr. opii comp.) acts admirably.

The diet should be simple and easily digestible,

such as milk and milk preparations, broths, custard, milk toast, etc. Anything which the patient desires and which does not distress him may be allowed.

If dyspnoea is a marked symptom, as it often is, besides absolute rest in a comfortable position, relief may be obtained from some of the diffusible stimulants, such as the aromatic spirits of ammonia, "Hoffman's anodyne," champagne, or the inhalation of oxygen gas. Strychnia is also of value for this condition. Generally, opium in some form will have to be pretty constantly employed, as it is, perhaps, the one best reliance for such cases.

CHAPTER VIII

ESPECIAL METHODS OF TREATMENT

"All methods of treatment end in disappointment of those extravagant expectations which men are wont to entertain of medical art."

O. W. Holmes.

Various anti-tuberculosis serums and innumerable drugs and special methods of treatment have been and still are brought forward by their enthusiastic advocates, as exercising a specific influence upon tuberculosis, either by their inhibitive or destructive influence upon the tubercle bacillus and its toxins, or by their influence in promoting the formation of fibrous tissue, such, for example, as creosote, arsenic, mercury, iodine, the alkaline hypophosphites, raw meat and raw meat juice, and many others. None of these "short-cut" methods of arresting the disease, however, has proved of any specific value, and, from the nature of the disease, probably no specific ever will be discovered. There are two especial methods of treatment used in connection with the usual hygienic-dietetic measures which have established themselves as of more or less value in selected cases by long experience and observation. They are tuberculin and artificial pneumothorax.

Tuberculin

Tuberculin, first originated by Koch, is the product derived from cultures of the tubercle bacillus, either in the form of the filtered extract of the bacillus, containing its dissolved toxic products, as in Koch's old tuberculin (O. T.), or it may be composed of the pulverized insoluble substance of the bacilli themselves, the "bacillen-emulsion" of Koch. There are very many tuberculins depending upon the various methods of preparing them, but they are all essentially the same and act in the same way. Probably Koch's old tuberculin, (O. T.), and his bacillen-emulsion, "new tuberculin" ("B. E.") are the most frequently employed in the therapeutics of tuberculosis, although each variety has its advocates. Whatever the method of production employed, or the exact composition of the tuberculin, it contains, of course, no living tubercle bacilli.

The theory of the action of tuberculin is that active immunity is produced,—not immunity to the tuberculosis, as anti-diphtheritic serum does to diphtheria,—that is, passive immunity; but a stimulation of the defensive powers of the body is produced, and more anti-bodies are formed to contend with the toxins of the bacilli. The action of tuberculin is solely towards the specific infection, and it has no effect upon a healthy person. It is not a cure, only in properly selected cases it may be said to be a favorable factor, how favorable we cannot say.

Trudeau, the famous physician of Saranac Lake

in the Adirondacks from his long and extensive experience, thus conservatively states the case: "My experience with the tuberculin treatment thus far has led me to believe that when carefully applied in suitable cases, it has seemed to have some favorable influence in bringing about healing of the lesion."

The suitable cases for the use of tuberculin are those in which there is a fair degree of resistance and in which the general condition is good, and in this class are included (a) early cases with small local lesions; (b) moderately advanced cases which have remained stationary under the usual hygienic-dietetic treatment; and (c) cases in which the physical signs are extensive, but with slight constitutional symptoms. Mild fever is not a contraindication if the nutrition is good. The fundamental condition in all cases for the use of tuberculin is that there should be a fairly good resistance; otherwise, the tuberculin will do harm. Tuberculin can be safely employed in ambulant cases, as is done in many clinics, and in the doctor's office; but the patient must be perfectly able to come to the dispensary or office.

The technique of the tuberculin treatment is now easy, since the proper dilutions can be readily obtained from reputable firms. The main point to bear in mind is to begin with small doses and increase so slowly that no reaction occurs. Having selected the tuberculin to be used, for instance, Koch's old tuberculin (O. T.), one begins with a

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dose of 0.000.0001 c.c. to 0.000,001 c.c. and gradually increases it by twice the first dose, then three times, four times, etc., the first dose, until finally the maximal dose of 1.0 c.c. is reached, which is usually in about six months. The intervals between the doses is generally three or four days, and this interval is maintained as long as the patient is doing well. If, however, a slight reaction should occur, the interval should be increased to one week, and the dose diminished. A subcutaneous syringe graduated in tenths of a c.c. is employed, the dose being so many tenths of a c.c. of the dilution used. The injection is preferably given in the back at the angle of the scapula, and the usual antiseptic precautions observed. If a reaction occurs, it is indicated by a rise of temperature, a loss of weight, headache, and general malaise, a focal reaction by changes in the pulmonary signs, and, locally, by pain, tenderness or swelling at the site of injection. Of the general reaction, the most important signs are fever, loss of weight and general depression.

If the tuberculin treatment is successful, it is indicated by an improvement in the appetite and digestion, increase in strength and usually in weight. Other evidence of improvement may also be noted.

When the higher doses are reached, the intervals can be longer, from two to four weeks. There can, obviously, be no fixed doses, as the resistance of the patient is an uncertain factor. Each one must be individualized, both as to the dose and as to its increase.

The main object to be attained in the tuberculin treatment is to gradually increase the tolerance to it to the highest point attainable, avoiding reaction. It is well again to repeat that tuberculin is not a cure, but only a favorable factor in certain cases, and it does not by any means take the place of the hygienic-dietetic treatment, but is only to be used in connection with it. With ordinary care and constant supervision of the patient, tuberculin used according to the above precautions can with safety be used by any physician.

Artificial Pneumothorax

Artificial pneumothorax, as its name implies, is the production of a pneumothorax in the pleural cavity of the diseased lung for the purpose of collapsing the lung, and it is accomplished by injecting air or nitrogen gas, generally the latter, into the pleural space. The object to be attained is the immobilization of the lung, the promotion of the formation of connective tissue, the collapsing of cavities, and a reduction of toxic absorption. It is applicable to only a limited number of cases, chiefly to those in which there is extensive unilateral (or chiefly so), progressive or chronic disease which fails to respond to the ordinary hygienic-dietetic measures. It has also been successfully employed in recurring or very severe hemorrhages which failed to yield to other treatment, provided, of course, it was determined from which lung the hemorrhage came.

Artificial pneumothorax is, in one sense, a last resort in that it is chiefly applicable to those cases which, under any other treatment, seem doomed; and experience has shown that many such cases have been saved by it. This operation has also been recommended and, indeed, employed in earlier cases which appeared to have no recuperative power or showed no improvement under the ordinary measures of treatment. In far-advanced cases it has occasionally produced an arrest of the disease, or an amelioration of the symptoms. The cases of choice, however, are those chiefly or entirely unilateral when there is still a fair amount of resistance, and such cases are comparatively few.

It is not always possible to induce a pneumothorax on account of pleural adhesions.

The operation in one sense is a simple one, so far as the operation itself is concerned, but it requires much experience and careful manipulation in order that the lung may not be punctured and gas injected into the circulation, producing gas embolism. It is also quite essential that one should possess the knowledge which the X-ray picture of the chest gives, so as to select the most favorable site for the puncture and to determine the condition of the pleura as to adhesions, and subsequently to note the effect of the injection, to be sure the gas is in the pleural cavity and to see how far the collapse has advanced. A special apparatus is also necessary, with a manometer to indicate by the oscillation of the fluid in it whether or not the needle

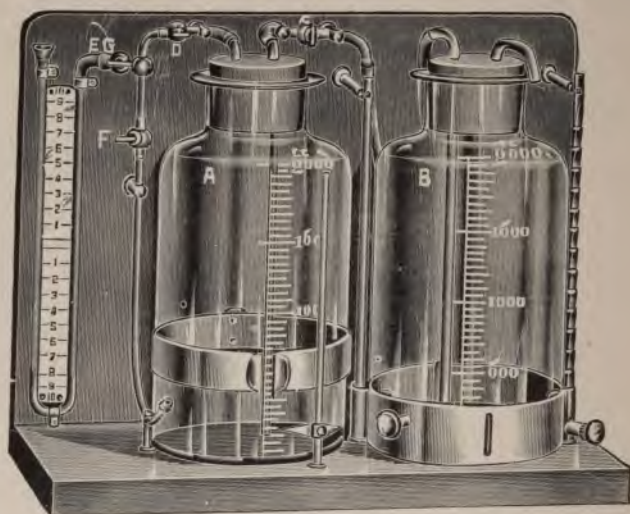


Fig. 19. Dr. Samuel Robinson's apparatus for artificial pneumothorax

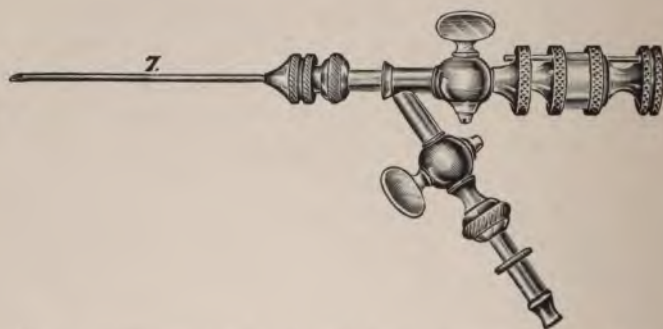


Fig. 20. Illustrates a needle which Dr. Cleaveland Floyd has designed

Kindness of Codman & Shurtleff, Inc., 120 Boylston St., Boston, Mass.

is in the pleural cavity, and also the pressure. (Figs. 19, 20.) The operation is performed under careful antiseptic conditions and for the first weeks of treatment the patient as a rule should be kept quiet in bed. Local and anæsthesia alone is required. The following solution being used:

R	
Novocaine	0.5
Adrenalin	1.0
m Aquæ distill.	100.

Or eucaine with adrenalin may be employed for the same purpose. Of the novocaine solution thirty minutes is generally sufficient. Not only the superficial parts but the pleura itself should be anæsthetized. Although the general physician will usually refer the cases he thinks suitable for artificial pneumothorax to the expert, still he should know something about the operation and its effects, as well as what class of cases is likely to be benefited by it, in order that he may intelligently advise his patient.

If the first application succeeds and one feels sure he is in the pleural cavity, 200 to 300 c.c.'s of the nitrogen gas are injected and in a day or two the same amount or more, until gradually the lung is more or less fully collapsed.

As has been said above, the patient should be kept quiet for several weeks until the changed conditions in the circulation from the pressure have adjusted themselves. Later, he can be up and, possibly, come

to the clinic or office for the refillings which need only to be done at quite long intervals after collapse has once been well established. Compression should be maintained for a long time,—a year or more.

If the operation is effective, the result is shown in a decrease of the temperature and pulse rate, disappearance of night sweats, improved appetite and digestion, and a general feeling of well-being. The cough and expectoration may at first be increased, but after a few days decrease and may entirely disappear.

So far as danger is concerned in the operation itself, one can say that, in skilled hands, if a careful technique is observed, it is practically free from danger; so that if it does no good, it will do no harm.

The evidence now at hand abundantly proves the value of artificial pneumothorax as an additional weapon in the treatment of tuberculosis. As Prof. Saugman says: "It has fully justified its place in the treatment of some severe cases of pulmonary tuberculosis, and, that by it, recovery sometimes may be obtained when any other treatment would have failed."

CHAPTER IX

TREATMENT OF SPECIAL SYMPTOMS

“‘Fortune always leaves some door open in disasters, whereby to come at a remedy,’ said Don Quixote.”

“The means that heaven yields must be embrac’d
And not neglected; else if heaven would,
And we would not, heaven’s offer we refuse.”

Richard II, Act III, Sc. 2.

Debility, Anorexia and Loss of Weight

One of the prominent and early symptoms of pulmonary tuberculosis is debility, often accompanied by loss of weight. The first and most important step in the treatment of this condition is rest in the open air and proper and abundant food, rich in proteids and fats. It will often be found that a patient can take and digest a larger amount of food than in health if properly prepared and made appetizing, but it may have to be given in small amounts at frequent intervals. It is well in this connection to remember the saying of Dettweiler, “My kitchen is my pharmacy.” One cannot give too much attention to the food question of his consumptive patient.

If the appetite is wanting, some of the bitter tonics may be employed, such as *nux vomica*, gen-

tian, calumba, cardamom, cinchona, often combined with advantage with the mineral acids or Italian vermouth. Again, the compound syrup of hypophosphites, or some of the malt preparations will be of assistance. The following is recommended by Burton Fanning as particularly useful, both in stimulating the appetite and remedying various digestive disturbances, such as flatulence and distension:

R

Sodii bicarb.	grs. xv (1.0)
Tr. nucis vomicæ	mvii (0.4)
Tr. gentianæ	ʒss (2.0)
Aquæ chloroformi ad	ʒi (30.0)

℥ Sig. The above at a dose before meals.

Constipation, if present, must be corrected by food or laxatives, as has been previously indicated, and digestive disturbances counteracted by appropriate treatment as will later be considered.

Anæmia

As a matter of routine, the blood should be examined both as to the percentage of hemoglobin, and the number of red blood-corpuscles. If evidences of anæmia are found—the secondary anæmia of tuberculosis—in addition to nourishment and fresh air, iron in some form is indicated. One can either employ some of the older preparations, such as the chlorid and carbonate of iron or the syrup of the iodid, or one of the many new preparations, such as ferro-mangan, ovoferrin, pro-

ferrin or triferrin. It is also to be remembered that a diet rich in iron, such as the yolk of an egg, whole wheat, red meat, green vegetables, etc., may furnish the needed iron.

Arsenic comes next in importance to iron in the drug treatment of anæmia, and here we may employ either the simpler forms, such as arsenious acid $\frac{1}{40}$ gr. dose, or Fowler's solution, beginning with 3 or 4 drops and gradually increasing to 7 drops; or some of the more complex preparations, such as sodium cacodylate $\frac{1}{2}$ to 2 grs. in pills or hypodermically, which is considered less toxic than the ordinary preparations of arsenic and less apt to cause digestive disturbances. Sodium arsenate $\frac{1}{100}$ to $\frac{1}{20}$ gr. or elarson $\frac{1}{8}$ gr. are other preparations. Arsenic and iron can also be employed with advantage in combination, and can be given subcutaneously in the form of citrate of iron .05 and sodium arsenate .001 the injections to be given in the gluteal region or in the deltoid muscle twice a week. Iron arsenate $\frac{1}{16}$ – $\frac{1}{12}$ gr. arsenoferratin $7\frac{1}{2}$ grs, three or four times a day, and arsentriferrin 5 grs. are other combinations. Strychnia, an excellent nerve tonic, may also be combined with one or both of the other two drugs, as iron arsenate and strychnia, or citrate of iron .05, sodium arsenate .001 and strychnia .001, or citrate of iron .05 and strychnia .001, given subcutaneously. These combinations for subcutaneous injection can be obtained in ampules. Hemaboloids arsenated with strychnia is said to be a favorable combination of the three drugs.

Gastro-Intestinal Disturbances

Digestive disturbances frequently occur in tuberculosis and are to be treated according to the indications very much as in other diseased conditions. As it is of the utmost importance that the tuberculous patient should efficiently digest and assimilate his food, careful and immediate attention should be given to any digestive irregularities. The main reliance should be upon a careful selection and preparation of the food. It may be necessary to have recourse to a test meal and examine the stomach contents, or investigate the dejections in order to determine the cause of the disturbance and the appropriate treatment. If constipation is present, that should be relieved. If the normal digestive ferments are defective in activity and deficient in quantity, some form of pepsin, either alone or in combination with hydrochloric acid or lime juice, to which some of the bitter tonics can be added, are indicated. If there is much fermentation and gas, such remedies as creosotal one or two drops, pancreatin 5 grs., salol 5 grs., charcoal, spirits of chloroform, 20 minims to one fluid drachm, asa-fœtida 5 grs., or a brisk cathartic are to be employed according to the indications. When there is gastric pain and distress after eating accompanied perhaps with nausea and vomiting, menthol 1 or 2 grs. and bismuth with bicarbonate of soda are useful. In every case the diet must be carefully regulated; fried and rich foods must be avoided and one may be obliged to have recourse to especially

prepared food, such as milk with Vichy or Apollinaris water, kumiss, beef juice, etc.

When there is a general nervous condition coincident with the gastric disturbance, or perhaps its cause, Bonney¹ strongly recommends the following as of value from a long experience in its use:

R

Strychnin $\frac{1}{80}$ gr.

Salol 5 gr.

Aqueous ext. of opium, $\frac{1}{10}$ gr.

Ext. cannabis indica $\frac{1}{15}$ gr.

Aloin $\frac{1}{40}$ gr.

m Sig. The above to be taken in capsule after meals.

Vomiting

This is a serious symptom, as it often entails the loss of a meal, and thereby interferes with the nourishment of the patient. It is caused either reflexively from the cough, or from irritability of the pharynx or from gastro-intestinal disturbance. Vomiting occurs frequently after breakfast, the taking of food excites coughing, and the coughing results in vomiting and the loss of the meal. To obviate this, a warm drink, such as a glass of milk, a cup of coffee or beef tea or Vichy or Apollinaris water is taken on awakening. The warm drink excites the inevitable morning paroxysm of coughing and clears out the accumulated secretions, and later the breakfast can be safely taken. If the pharynx

¹ "Tuberculosis and Its Complications," Phila., 1908.

is irritated, anesthesin, orthoform or novocaine can be applied locally. When there is gastric irritability anesthesin can also be employed internally, codein, oxalate of cerium or chloroform water.

Diarrhœa

Diarrhœa may occur in any stage of pulmonary tuberculosis, either from digestive disturbances or from a tuberculous involvement of the intestinal tract. In the latter case it generally occurs in the late stages of the disease. If from digestive disturbances, the principal indication is the regulation of the diet; for a day or two a milk diet or milk foods with toast may be all that is necessary, first cleansing the alimentary canal with castor oil or calomel. If medication seems indicated bismuth salicylate is perhaps the best remedy, a teaspoonful of the powder taken with meals. Tannigen 3 to 10 grs. (0.2 to 0.7) four times a day dry on the tongue, followed by a swallow of water or mixed with food, and tannalbin 15 to 60 grains (1.0 to 4.0) in powder or tablets followed by water or in gruel, are other useful remedies. In the diarrhœa of tuberculous ulcerations the above remedies may be of avail; or others are oxid of zinc with bismuth, the lead and opium pill and the fluid ext. of coto bark. Irrigation of the rectum is also sometimes beneficial. Great care should be taken with the diet, which should consist of bland substances, such as milk and milk preparations, arrowroot, meat broths, etc.

Cough

Cough is often such a prominent symptom that the patient thinks if he can obtain relief from it his disease will be equally benefited, and he, therefore, insists upon some cough remedy. One should be very cautious, however, about yielding to the patient's importunity unless there seems to be an imperative indication for therapeutic interference. Under the open-air treatment the cough often takes care of itself, and, furthermore, the patient can be trained to suppress much unproductive coughing, for like other constantly recurring acts, coughing becomes oftentimes a habit and is yielded to upon slight provocation, when not necessary for the removal of secretion.

In spite of the general treatment, however, and the endeavor to control it, the cough becomes so troublesome at times that some active interference is indicated. Treatment is necessary when (a) the cough is incessant, disturbing the rest of the patient and seriously dissipating his strength, for coughing is violent exercise; when (b) the cough is ineffective, or hard, and it requires a continued paroxysm to expel the secretions; and when (c) the secretions are excessive and more or less continuous, coughing is necessary to get rid of them. Not infrequently all three causes are operative. The object to be attained in treatment is to restrain the cough within the limits of effectiveness and lengthen the intervals. If the cough is hard and ineffective some expectorant is indicated, such as the chloride of

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ammonium or the aromatic spirits of ammonia, a teaspoonful of the latter in a glass of water and frequently sipped is most useful. With these, codein or heroin may be combined. The syrup of hydriodic acid is another remedy of value for this condition. Inhalations of thymol, eucalyptus, pine needle oil, tr. benzoin comp. and creosote are other means which may give relief.

When the secretions are excessive, such remedies as terpin hydrate, eucalyptus oil, the compound tincture of benzoin and creosote are indicated. Creosote can be employed by inhalation by means of a perforated zinc inhaler, the medicament being dropped upon a sponge placed in front of the inhaler and the following prescription can be used for this purpose:

℞ Menthol	grs. v. (0.66)
Alcohol	} aa ʒiiss (10.00)
Creosote	
Chloroform	

℥ Sig. Put 5 to 10 drops on the inhaler and inhale the vapor for half an hour to an hour or more.

If the upper air passages are irritable and dry, some of the soothing inhalations or sprays may be used, composed of alkaline solutions, or menthol, eucalyptus, camphor or carbolic acid in liquid alcohol or petroleum. The following is a local application for the pharynx:

- ℞ Iodin grs. ii-v (0.1-0.3)
Potass. iodidi grs. xvi-xlvi (1.0-3.0)
Glycerini ℥iiss (10.0)
℥ Sig. Apply every day or every second day.

When the cough is persistent and harassing, far in excess of the result produced — the elimination of secretions — and is interfering with nutrition and rest, one will often be obliged to employ some sedative agent, although simple remedies should first be tried, such as demulcent drinks, as sea-moss, or flax-seed tea, acacia, lacturarium, gelatine, or some form of lozenge. Of the opium sedatives, codein, heroin and dionin are the least objectionable and can be administered in capsules, tablets or in solution, either alone or in combination with chloroform spirits or water, or aromatic spirits of ammonia. The doses are codein, grs. $\frac{1}{4}$ to $\frac{1}{2}$ (0.01-0.03); heroin, grs. $\frac{1}{24}$ to $\frac{1}{12}$ (0.0025-0.005); dionin, grs. $\frac{1}{8}$ to $\frac{1}{2}$ (0.01-0.03).

The following are some simple prescriptions containing the above:

- ℞ Heroin, grs. ii (0.13)
Spts. ammon. aromat. ℥v (20.0)
Aquæ ad ℥iv (120.0)
℥ Sig. One teaspoonful in water three or four times a day.

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℞ Dionin grs. v (0.2)
 Aq. amygd. amar. ℥iss (45.0)
 Aquæ ad ℥iii (90.0)
 ℥ Sig. One teaspoonful three or four times
 a day.

℞ Codeinæ, grs. viii-xvi (0.5-1.0)
 Syr. pruni virg.
 Aquæ āā ℥ii (60.0)
 ℥ Sig. One teaspoonful three or four times
 a day.

℞ Heroin grs. 1-1½ (0.06-0.09)
 Spts. chloroformi ℥ii-℥iii (8.0-12.0)
 Aquæ menth. pip ℥iii (90.0)
 ℥ Sig. Teaspoonful three or four times a day.

"Not until all hope of recovery has vanished," wisely remarks Bonney, "should the comfort of the patient with distressing cough be promoted by the *free* exhibition of morphine, heroin or codeine."

Fever

As with the cough, the main reliance for combating this symptom is out-of-door air and rest,—absolute rest,—as has been previously insisted upon. The patient may have to be kept at rest for weeks or months before the fever subsides, but so long as there is any hope of arresting the disease, the rest treatment must be maintained while the fever exists. The sleeping porch is the best place for the fever patient, but if this is unattainable, a well-

ventilated room with open windows is the next best arrangement; in the latter case the patient may be carried out to a couch or reclining chair upon a piazza for a portion of the day if it can be done without disquieting him.

The employment of antipyretic drugs should, as a rule, be avoided, as they have but a transitory and deceptive effect; the only one I ever employ is pyramidon 5 to 6 grs. (0.3-0.4 gms.) either given in the form of tablets or in solution. In the latter case the requisite dose is dissolved in a glass of water and slowly sipped during an hour. Taken from three to six hours before the expected rise of temperature, a single dose is usually sufficient for twenty-four hours. I have sometimes found that a few doses of this drug will render the patient free from fever for a considerable time, and this fever-free interval will enable him to gain in weight and strength. Pyramidon can be used for a long time and according to Saugmun the cases of fever in tuberculosis which are not favorably influenced by it are few. It must always be remembered, however, that the main reliance in the fever of tuberculosis is fresh air and rest.

Night Sweats

Genuine night sweats are profuse and cover the patient with moisture so that his night garments are saturated. They must be distinguished from the comparatively slight perspiration common to any weakened condition which is often called

"night sweats" by the patient. The real night sweats are usually a concomitant of the fever and are the result of toxic absorption. Like the fever, the main treatment is fresh air and rest. The bed clothing should be of light weight and only enough to render the patient comfortable. After the sweating has occurred the body should be rubbed dry and the night clothes changed. On retiring a glass of warm milk with one or two teaspoonfuls of brandy, as recommended by Brehmer, is often of aid, as is also bathing the body with cool water and vinegar or dilute acetic acid, which can also be done in the late afternoon.

If the above general procedure does not avail, symptomatic drug treatment may temporarily be indicated and the two remedies I have found most efficient are agaracin gr. $\frac{1}{10}$ and camphoric acid grs. 30, given in powder an hour or two before bedtime. Instead of the simple camphoric acid, one can use the pyramidon acid camphorate 12 to 15 grs. (0.75-1.0) in powder or aqueous solution, and thus the one preparation is effective both for the fever and the night sweats.

Hemoptysis

This is one of the most alarming symptoms to the patient and his friends, for it is often the first real evidence that tuberculosis may exist; "the stoutest heart quails under it." As a matter of fact it is never fatal in the early cases and rarely so in more advanced ones. It may, however, much

weaken and discourage the patient and may lead to the development of broncho-pneumonia,—a very serious complication.

Most cases of hemorrhage would subside spontaneously without medicinal treatment if the physician and patient were content to trust nature; but almost invariably active treatment is demanded. If the hemorrhage is so slight as only to cause "streaked sputum," no treatment is indicated except to refrain from active exercise and keep in touch with the physician. When the hemorrhage is more than this and active treatment is indicated or expected, the principle upon which one proceeds is that of lowering the blood pressure and thus favoring coagulation; hence one should, if possible, at the first ascertain the blood pressure.

The practical plan of procedure, modified, of course, by individual conditions, may be summarized as follows:

(a) Absolute rest in a well-ventilated room, in a semi-recumbent position. As Dr. James Jackson sixty years ago wisely said: "Rest of body and mind, and 'holding the tongue' are quite as important at the moment of bleeding as the medicinal articles."

(b) An ice bag to the chest and cracked ice by the mouth.

(c) Unless the blood pressure is abnormally low, the inhalations of the fumes of nitrite of amyl., using the glass pearls, or spirets containing three or five minims, or $\frac{1}{100}$ gr. nitroglycerine, either sub-

cutaneously or upon the tongue; later, the nitrite treatment may be continued, if necessary, by sodium nitrite gr. i, every three or four hours for a day or two.

(d) Purgation by the use of one ounce of magnesium sulphate, given twice, the first dose soon after the initial attack, and the second dose on the second day.

(e) If the cough is annoying and frequent, small doses of codein or heroin, frequently repeated, $\frac{1}{4}$ gr. of the former and $\frac{1}{12}$ to $\frac{1}{6}$ gr. of the latter. One should be very cautious about giving morphin or continuing its use, although there may be occasions when one-eighth of a grain or even one-fourth may be indicated, given subcutaneously. The continued use of the morphin is not without danger, for it may favor the development of bronchopneumonia.

The diet should be liquid and cold for the first day or two, such as milk with an alkali, soups, ice-cream, gelatine preparations, wine-jelly, etc. The patient should be kept quiet in bed one week after all traces of blood have disappeared.

Where the hemorrhage is severe and recurring, such as more frequently occurs in the latter stages of the disease, and the above means do not prove effective, there are other remedial measures which may be tried. Blood serum from the horse or rabbit has been employed with success; either fresh rabbit's blood serum in 15 c.c. doses subcutaneously, repeated at intervals of four hours or longer, can

be used, or the normal horse serum previously prepared, and now furnished in vials or syringes. In cases where the hemorrhage is recognized as coming from one lung and there is little active disease in the other, artificial pneumothorax, when it can be employed, has proved effective, but its use presupposes a pleural cavity free from adhesions or sufficiently so to allow adequate compression of the lung.

Other remedies are atropine sulphate $\frac{1}{50}$ gr. subcutaneously, and pituitary substance or extract, said to be of especial value when the heart is very rapid and the respirations are increased. Chloride or lactate of calcium 10 to 20 grs. (0.6–1.2), or calcium sulphide 1 gr. (0.06) have been used with apparent success by some, but in my experience I have not found them of any great value.

An old procedure is the application of ligatures to the extremities with a bandage of any kind,—a towel, sheet, or rubber tubing. First one thigh is constricted and then the other, and, if necessary, the arms in a similar manner. After half an hour or an hour, the bandages may be removed, one at a time. If the hemorrhage is so severe that the patient becomes exsanguinated, such remedies are indicated as in any case of great loss of blood, the infusion of physiological salt solution, and cardiac stimulants such as aromatic spirits of ammonia, champagne, oxygen, etc. When the blood fills the bronchi and upper air passages, coughing and deep breathing should be encouraged in order to get rid of the effused blood.

Pain

Pain in the chest, a frequent symptom, must be treated according to the cause if it can be determined. If it is pleuritic, strapping the chest with adhesive plaster will generally give relief. When the cause is not evident, external applications, such as a belladonna or mustard plaster, tincture of iodine, heat or an appropriate liniment may be employed. In other cases, aspirin or, exceptionally, a subcutaneous injection of codein or morphia may be required. Neuralgic or rheumatic pains and others of indefinite origin are to be treated by external applications and internal medication as the indications require.

Insomnia

If the cough keeps the patient awake, this must be appropriately treated as indicated above, so also as regards night sweats. The best hypnotic is the open-air life and will generally suffice. It occasionally happens, however, that a patient cannot sleep well out of doors from nervousness or inability to keep warm, and under such circumstances it is better to sleep indoors; but the bedroom should be quiet, well-ventilated and darkened, or else one should cover the eyes with a dark bandage. A quiet, restful evening, and a glass of warm milk or a light meal at bedtime will conduce to a good night's sleep. Care should be taken that the feet are warm, for one cannot sleep with cold feet. If any drug is considered necessary, I have found trionol 5 to 10 grains the most satisfactory one.

Dyspnœa

This is not infrequently a distressing symptom in the advanced stages of the disease, and when there is extensive fibroid infiltration, thus greatly reducing the respiratory capacity. The main indication is the restriction of the respiratory demands, within the smallest compass possible, by rest. Temporary relief may be obtained by some of the diffusible stimulants, such as ammonia, Hoffman's anodyne, and oxygen; strychnia and arsenic are also of value. When all else fails, opium in some form will be the last resort.

Laryngeal Tuberculosis

This complication is usually secondary to pulmonary tuberculosis and when advanced it is a very distressing and grave one. The diagnosis of laryngeal tuberculosis is not easy: hoarseness and pain in a tuberculous individual is strongly suggestive of it, but not proof, for other conditions may cause these symptoms, such as syphilis, and the disease may be present while the symptoms are absent. The characteristic local signs of a well-marked case are more or less infiltration of the laryngeal tissues with loss of tissue and ulceration.

The general treatment is that of the pulmonary disease, the open-air régime and rest of the larynx, — absolute interdiction of talking, whispering not even being allowed. Local treatment will depend upon the stage and character of the local condition; in mild cases little or no topical treatment is indi-

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cated. When direct applications are to be made to the larynx, it will generally be wiser to call in the aid of one skilled in doing this and, hence, only such local treatment will be mentioned as the general practitioner can readily apply.

In the first place, the larynx must be kept clean with some alkaline spray, such as Dobell's solution, to which rose-water may be added, one drachm to the ounce, which may be followed by a spray of argyrol ten to twenty per cent. solution. When there is pain and much discomfort, a spray of the following will give relief, the patient inhaling while it is applied:

- ℞ Menthol grs. v (0.3)
 Liquid petroleum ℥i (30.0)
 ℥ Sig. Use in vaporizer.
- ℞ Menthol grs. iv (0.25)
 Olei eucalypti
 Olei gaultheriæ āā grs. xvi (1.0)
 Liquid petroleum ℥iii, ℥ii (100.)
 ℥ Sig. Use in vaporizer.

or simple liquid petroleum may be used. Medicated steam inhalations are also soothing. Lyon¹ recommends the following:

¹ A Report of 241 Cases of Larygeal Tuberculosis treated at the Rutland State Sanatorium (Mass.)—*Boston Medical and Surgical Journal*, July 2, 1914.

℞

Tr. benzoin co. ℥i (4.00)
Eucalyptol 4 minims (0.25)
Menthol 2 minims (0.12)

℥

When the epiglottis is involved and there is dysphagia, some local anæsthetic must be employed before eating, such as orthoform, anesthesin, a spray of two per cent. cocaine, or of heroin, three grains to the ounce.

Much attention must be given to the feeding of the patient under these circumstances, else he will die of starvation. Small amounts of highly nutritious food, of a bland and semi-solid character must be given, such as eggs, raw, minced meat, junket, milk and milk preparations, minced chicken, thick soups, wine jelly, etc. Butter, olive oil and cream should be employed as much as possible in the preparation of the various articles of food.

There are many other local applications and procedures which can be employed in the different stages of laryngeal tuberculosis, but these are best left to the skilled laryngologist. It is well to repeat, however, that the basis of treatment of this condition is *complete rest* of the larynx and the rigid execution of the open-air treatment.

CHAPTER X

TUBERCULOSIS IN CHILDREN

"In order to save a race that is threatened by an infectious disease, the best plan is to save the cocoon."

Pasteur.

"Tuberculosis of the adult is the end of the song begun at the cradle."

Von Behring.

There are certain peculiar difficulties in the diagnosis of tuberculosis in children which do not exist in adults. In the first place, active tuberculous disease of the lungs is infrequent, and, second, tuberculous bronchial glands are much more frequent; therefore, in making an early diagnosis, we have to make it chiefly from the symptoms — the detection of the diseased bronchial glands — and by the tuberculin test. If it is true, as is now generally held, that the majority of consumptives are infected when young, the importance of detecting the disease in childhood is at once apparent, for then is the golden opportunity of so regulating the child's life that the latent tuberculosis may never become active.

Symptoms

What are the suspicious symptoms?

In general, they are those indicating a definite

depression of health, such as loss of weight or failure to gain in weight, anæmia, malnutrition, loss of appetite, lassitude, irritability, and sometimes a dry, hard cough and night sweats. There may be also an irregular rise of temperature. It is true that all or many of these symptoms may occur from other causes and are not characteristic of tuberculosis; but they should always make one suspicious and prompt a thorough examination and continued observation. It is also true that tuberculosis may exist and yet there may be no evidence of serious disturbance of health or no marked constitutional symptoms, but in this case no treatment is required other than good hygiene, for the defensive resistance of the body is equal to the attack of the tuberculous infection. This is especially true in later childhood. If there is a family history of tuberculosis, or an active case in the child's family, this fact should make one all the more suspicious.

Physical Signs

The physical signs are also not characteristic. On inspection the child may show evidence of anæmia and malnutrition. On percussion there is nothing definite; there may be slight dullness on one side or the other of the sternum at the level of the second intercostal space in front and in the interscapular region behind. Auscultation is no more satisfactory. We have the D'Espine sign, often difficult to make out, of questionable value, and only to be obtained when the bronchial glands are of

considerable size. It consists in the persistence of the bronchial whisper or bronchophony heard over the vertebræ below the level of the seventh cervical spine. When positive, it merely indicates the enlargement of the tracheo-bronchial glands, but tells us nothing as to the cause or nature of the enlargement. Another sign, when it can be determined, is diminished respiration over one lobe, especially the right lower lobe.

When all is said, however, percussion and auscultation give but little definite information unless there is lung infiltration or consolidation.

The X-Ray

The X-ray is of especial value in determining the presence of bronchial glands, but the Röntgenographs must be carefully made and interpreted by one experienced in X-ray work. When the glands are present, the plate shows spots of shading along the right side of the vertebral column, and also along the hilus. Here, again, it must be borne in mind that although the bronchial glands may be shown to be enlarged, the X-ray does not tell us whether they are actively tuberculous or not.

The Tuberculin Test

The von Pirquet cutaneous test is of the most value in diagnosis in children under five years of age. Of course, a positive reaction only indicates a tuberculous infection, but tells us nothing as to its activity. It is of greater significance when nega-

tive than when positive; but with other suggestive symptoms and signs a positive von Pirquet adds to the weight of evidence in favor of active glandular tuberculosis. With older children, the subcutaneous tuberculin test may be used, the dose, of course, being proportionately smaller than with adults; for example, with children of eight or ten years of age, 0.001 to 0.01 mg's of Koch's old tuberculin may be employed.

The conditions under which this test should be made are the same as with an adult. The patient should be afebrile; the reaction phenomena are also the same. Used with care and in proper doses, the subcutaneous tuberculin test is quite safe. Holt declares that he has seen no unfavorable symptoms from this form of the test even in the youngest infants.

The Diagnosis

In order, then, to make a definite or probable diagnosis of active bronchial gland tuberculosis, we must have enough or all of the following evidence:

(a) Constitutional symptoms, such as weakness, undue fatigue, malnutrition, anæmia, fever, rapid pulse and a dry cough without any discoverable physical signs of disease.

(b) A positive von Pirquet or subcutaneous tuberculin test.

(c) A positive D'Espine sign.

(d) X-ray evidence of enlarged bronchial glands.

Treatment

When we have established the diagnosis, the child is to be placed under treatment, which is, in general, that of the open-air régime. The diet should be abundant and rich in fats and proteids. The child should sleep under open-air conditions. There should be rest periods during the day and over-fatigue should be avoided. If there is no fever or other acute symptoms requiring complete rest, the child may for a part of the day attend an open-air school, where rest periods and lunches are afforded. Drugs are not generally indicated except for especial symptoms; if, for example, anæmia is present, iron or arsenic is indicated, such as the syrup of the iodide of iron or Fowler's solution. Tuberculin has been employed with varying opinions as to its value by those who have used it. Sunshine is important, and the child should be encouraged to rest and play in the sunshine.

Pulmonary Tuberculosis

When the child shows evident physical signs of pulmonary involvement, the diagnosis depends upon the interpretation of these signs, together with the evidence obtained from the symptoms, and when sputum can be obtained, upon the result of its examination. We may have signs of a bronchitis or a consolidation which may or may not be of a tuberculous origin. If the child has been exposed to the infection in the family; if a chronic cough develops; or fever not evidently caused by other con-

ditions; if consolidation is present and persists, particularly if it involves the middle lobe of the right lung anteriorly (Holt) the case is probably one of tuberculosis.

Slight or more marked physical signs must be interpreted very much as in the case of an adult, and be considered in connection with the symptoms. One does not so frequently hear rales in children as in adults, and the same physical signs in children are not always so significant of tuberculosis as with adults.

Treatment

The treatment of children with active pulmonary tuberculosis is practically the same as that for adults. If possible, the child should be sent to a sanatorium where the treatment, as a rule, can be more efficiently carried out. Outdoor sleeping, rest, nutritious food and sunshine are the essentials. It is of the greatest importance that the young child should be protected from all sources of infection, whether from the milk or a tuberculous individual in the home, and, likewise, its strength should be carefully conserved during the convalescence from measles and whooping cough, which diseases render the child peculiarly susceptible to the tuberculous infection. Later in childhood, when resistance to tuberculous infection or the extension of an already existing infection, is not well established, the child should be given such general care, in regard to fresh air, food, rest, bathing, etc., as will secure and maintain a high standard of health.

CHAPTER XI

CLIMATE IN THE TREATMENT OF TUBERCULOSIS

"The glorious sun,
Stays in his course and plays the alchemist;
Turning, with splendor of his precious eye,
The meagre cloddy earth to glittering gold."

King John, Act III, Sc. 1.

"Soon as a man finds himself spitting and hacking on rising in the morning, he should immediately take possession of a cow and go high up into the mountains and live on the fruit of that cow."

Celsus.

Before considering the uses of climate in the treatment of pulmonary tuberculosis, it will be well to get a clear idea of what we mean when we speak of climate. The climate of any locality is its average weather conditions, and by weather we mean all those atmospheric elements which are noticed by sight, feeling, or observed by instruments; and these include the temperature, humidity, wind, the condition of the sky as to cloudiness or sunshine, and the occurrence of precipitation as rain or snow. By the term *weather*, we mean these conditions as observed at a particular time or during a short period, while by *climate*, we mean the aggregate of

weather conditions extending over a longer period. The average value of these conditions of any region constitutes its climate; for example, we say that the winter *climate* of northern New England is cold with a considerable precipitation in the form of snow, and much cloudiness, but the *weather* of a single winter may be comparatively mild with little snow and much sunshine.

In estimating the climate of any region one must know the average range of the various climatic elements: (a) the average or normal temperature, its daily range, and the extremes of heat and cold; (b) the humidity, estimated as the average relative humidity; (c) the precipitation in inches; (d) the wind, its velocity and prevailing direction; (e) the number of clear, fair, and cloudy days. The latitude and longitude of the locality should also be known. Such data for a large number of resorts are now available from government weather bureaus; the climatic chart of New York will serve as an illustration. (Fig. 22.)

Since such favorable results have been obtained in any and all climates in the treatment of tuberculosis by the skillful application of the open-air régime, the rôle of climate does not now occupy the paramount place it once did. Formerly a change to a more favorable climate was considered the most essential factor in the treatment, and when once the patient had reached the climatic El Dorado, he was left to himself to follow his ordinary or an extraordinary mode of life with but little, if any,

CLIMATE OF NEW YORK, N. Y. LATITUDE, 40° 48'; LONGITUDE, 74° 0'. PERIOD OF OBSERVATION,
THIRTEEN YEARS.

	January.	March.	May.	July.	September.	November.	Spring.	Summer.	Autumn.	Winter.	Year
Temperature (Degrees Fahrenheit)											
Average or normal	30.1°	36.3°	59.0°	73.7°	65.3°	42.1°	47.5°	71.5°	54.3°	31.4°	51.2°
Average range	13.6	14.6	16.7	17.4	14.9	13.6					
Mean of warmest	36.7	45.9	69.5	83.7	74.4	50.9					
Mean of coldest	23.1	31.3	51.8	66.3	59.5	37.3					
Highest or maximum	64	73	94	99	100.2	74.					
Lowest or minimum	-6	3	34	57	36.0	7					
Humidity											
Average relative	72.4%	67.6%	65.0%	70.4%	73.8%	69.6%	65.8%	70.1%	70.7%	73.3%	69.7%
Precipitation											
Average in inches	3.50	4.07	2.74	4.46	3.90	3.34	10.06	12.40	10.36	9.70	42.52
Wind											
Prevailing direction	W.	N. W.	S. W.	S. W.	S. W.	N. W.	N. W.	S. W.	N. W.	W.	N. W.
Average hourly velocity in miles	9.7	11.3	8.5	7.5	8.8	10	9.8	7.6	9.3	10.2	9.2
Weather											
Average number of clear days	7.6	7.5	9.7	7.5	8.8	8.4	24.8	24.6	27.4	21.8	98.6
Average number of fair days	11.6	13.5	18	15.5	12.1	11.5	38.9	43.3	36.4	34.9	153.4
Average number of clear and fair days	19.2	21	29.7	23	20.9	19.9	63.7	67.8	63.8	56.7	252

Fig. 21

medical oversight. A few recovered and more died under this go-as-you-please plan.

Experience has demonstrated, however, that the open-air treatment can be successfully carried out anywhere, even in the crowded city; for more depends upon the method, the careful attention to details, the skilled medical supervision, and the complete fulfillment of the out-door life than upon any especial climate. Nevertheless, it is obvious that, with an efficient hygienic-dietetic method, favorable climatic conditions are an added advantage. The purer the air the more favorable the other climatic conditions, the more perfectly the open-air treatment can be effected. Other things being equal, we therefore desire to send the consumptive patient to that locality where he will obtain the pure air and as many as possible of the other climatic excellencies, with the purpose of more perfectly following out the out-door life.

The Favorable Climate

The essential favorable climatic conditions for pulmonary tuberculosis are: (a) pure air free from bacterial impurities, and dust; (b) the maximum amount of sunshine — good weather; (c) absence of or protection from high winds; (d) moderate dryness and more or less equability; (e) a medium or cool average temperature.

Altitude, as in mountain climates, has been regarded as an element of much value in its influence upon tuberculosis, and most excellent results have

As to the influence of a change of climate upon the local condition, experience has shown that it is often greatly benefited; there is a diminution of the cough and a lessening of the expectoration. In brief, although a change of climate does not exercise any specific effect, yet, if rightly selected, it may be expected to improve the general condition, as to appetite, nutrition, etc., and diminish local activity.

However valuable a factor a favorable climate may be, it must always be borne in mind that it is only a part of the general treatment and that not the most important one. Of first importance is proper hygiene, diet, and discipline, and skilled medical supervision. Without these the most favorable climatic conditions will prove elusive.

When is a Change of Climate Desirable

A change of climate may be desirable for many reasons: the prominent one is that it may increase the patient's chance of recovery. He may not be doing well where he is, and the climate of his present locality may be a particularly unfavorable one. The environment of the patient may be such, as to family, or social conditions, that a change is advisable. The temperament of the patient may be such that change of scene and new surroundings will conduce to a more favorable mental attitude. Proper control of the patient may not be possible where he is. Age, sex and complicating diseases are other reasons which may render desirable a

change. The financial condition of the patient is, of course, a determining factor in making any change, unless one goes to a state or charitable sanatorium. It is better to make the best of home conditions than to go to a more favorable climate and suffer deprivations.

When a change of climate is under consideration, the first point to be decided is whether the general and local condition is such that any change will be beneficial; and, second, the particular climate and resort most favorable for the individual case. Furthermore, one must determine whether the patient should go to an "open" resort in the selected climate or enter a sanatorium there.

Having decided upon the climatic resort, some knowledge of the local conditions should be obtained, such as its sanitation, facilities for comfortable living, and the presence of a reliable physician to whom the patient can be referred. Opportunities for amusements and religious observances are an important consideration for some patients.

Cases Suitable for a Change of Climate

The class of cases most suitable for, and most likely to be benefited by, a change of climate are:

(a) Early cases with slight local involvement and little or no constitutional disturbance.

(b) Further advanced cases in the quiescent state with no serious constitutional disturbance. These two classes of cases do well in the elevated regions, as in Colorado or New Mexico.

(c) Advanced cases with little general disturbance, and a moderate degree of resistance. A dry, moderately warm climate in regions of little or no elevation, such as southern California or the pine belt of the South, is most suitable for such cases.

(d) Cases of cavities, if not extensive and in which the disease is quiescent may be sent to the altitudes or the low-land regions.

(e) Cases more or less advanced in which softening and excavation are going on, accompanied with much cough and expectoration, and with more or less constitutional disturbance, if they can be comfortably transported, they may have their life prolonged and live more comfortably in a moderately warm, dry region, such as southern California or the southern pine belt; indeed, a quiescent condition of the disease may be established.

With regard to tuberculosis complicated with other diseases, such as kidney, liver or cardiac diseases, or diabetes, each patient must be individually considered. A climate that is favorable for the tuberculosis may be unsuitable for the complicating disease.

In contemplating a change of climate for any case of pulmonary tuberculosis, we have to consider, on the one hand, the physical condition of the patient, both constitutional and local, and his economic and social circumstances; and, on the other hand, the climatic characteristics of the proposed resort, its general topography, its social en-

vironment, and the opportunity of obtaining competent medical supervision. Only thus can one expect to obtain successful results from a change of climate.

Not all cases are suitable to be sent away at all, and this is always the first question to be settled when a change is under discussion. Rarely should a patient be sent far away who is suffering from acute symptoms, such as fever, etc.; nor should far-advanced, hopeless cases, as many have done and died far away from home. Others of little persistence and self-control, and who cannot be depended upon to carry out the plan of treatment, if sent away at all should go to a sanatorium where they can be under discipline.

Favorable Climates for Pulmonary Tuberculosis

The climates which have been found by experience to be favorable for tuberculosis in its curable stage are: (a) the high altitudes, as Denver, Colorado Springs and Estes Park in Colorado, all about 6000 feet high; Silver City (5800 feet), Albuquerque (5000 feet), and Fort Bayard (4450 feet) in New Mexico.

(b) The medium altitudes, as Saranac Lake in the Adirondack Mountains (1600 feet); Liberty, N. Y. (2300 feet); Asheville, N. C. (2250 feet), in nearly all of which resorts there are good sanatoria. Many other eligible climatic regions can also be found in the White Mountains, the Berkshires, Massachusetts, Vermont, Pennsylvania and

northern New York. In the southwestern and Rocky Mountain region of the United States there are many resorts of medium altitude, such as Las Cruces, New Mexico (3800 feet); Phoenix, Arizona (1100 feet); and Tucson (2400 feet). In southern California, sixty or more miles inland, there are various places with a mild, dry, sunny climate, such as Redlands (1350 feet), Riverside (800 feet) and the Ojai Valley (900 to 1200 feet).

(c) Of the sea-level resorts, there are many places in the dry southern pine belt with a mild sunny winter climate, such as Aiken, S. C.; Summerville, S. C.; Augusta, Ga., and others in North and South Carolina, Georgia and the interior of Florida. On the coast of southern California, there are San Diego, Los Angeles, Santa Barbara, Pasadena, and others with an eligible climate, both winter and summer.

The climatic resorts that have been mentioned are but a few of the many in different parts of the country which offer favorable conditions for pulmonary tuberculosis and which fulfill the essential climatic conditions, viz.: pure air free from dust, sunshine, protection from high winds, an average cool temperature, and moderate dryness.

In regard to the high altitudes, there are certain contraindications which should be mentioned; they are: (1) advanced age; (2) too great involvement or softening in both lungs; (3) cases complicated with kidney or heart disease, diabetes, asthma, or emphysema; (4) extensive fibroid infiltration

with dyspnœa; (5) cases in which there is great irritability of the nervous system; (6) advanced tuberculous laryngitis.

Dettweiler thus well sums up the advantages and limitations of climate in the treatment of tuberculosis: "A specific or truly immune climate does not exist. The value of a climate depends upon how perfectly it can aid in the production of improved nutrition and the restoration of all functions to a normal physiological standard, working through the body and mind to accomplish this. Tuberculosis can be cured in every climate where extremes do not exist. The individual condition of the patient alone determines the choice. To accomplish a cure the plan of treatment and the method of life the patient follows hold the first consideration."

open-air exposure, cool sponging, etc. Particular care should be taken to protect the child from the exanthematous diseases, whooping cough, diphtheria and tonsilitis, and if it contracts any of them, the convalescence should be carefully guarded. In artificial feeding, the milk should either be obtained from tuberculin tested cows or be pasteurized, and this is done by heating the milk in an Arnold's pasteurizer or a home-made one of similar construction, to 145° F. for at least twenty minutes and then cooling it rapidly. As the child grows older, all hygienic measures should be taken to strengthen it, as has been indicated in Chapter X. When a case of tuberculosis exists in the family, every child should at once receive a careful examination.

Prophylactic Measures in the Case of an Adult Suffering from Pulmonary Tuberculosis

In the case of an adult tuberculous person at home, the physician must see to it that he has careful and detailed instructions as to the safe disposal of his sputum and the safeguarding of the family, and subsequently watch must be kept to see that the instructions are rigorously carried out. In the house the ordinary paper sputum receptacle is convenient, which can be burned with its contents; abroad, pieces of gauze or Japanese paper, folded several times, can be used and then put in an impervious paper bag, which is subsequently burned. Such an arrangement is less conspicuous than a pocket spit cup. The use of the common handker-

chief is obviously dangerous. In coughing, one should not do so in the presence of others, and should hold a piece of cloth or paper handkerchief before his mouth. The mouth should be cleaned frequently, at least before meals, with some alkaline solution, and the teeth brushed before and after meals. The hands should also be washed before eating.

A beard or mustache is not desirable, for it may collect particles of sputum. The patient should not handle articles used by children or others, or leave articles about which may be handled. If all the dishes used at the table are washed in boiling water, it does not seem to me necessary for the patient to have his own separate set, as is often recommended, and to do so makes an unpleasant distinction. It is to be borne in mind, as Baldwin truly says, that "the careful, cleanly consumptive has a right to associate with other people in the ordinary pursuits of business and pleasure." On the other hand, every consumptive has an obligation to "protect his fellow human beings so far as possible from the disease." The patient should sleep by himself, and, if possible, in a separate room.

A "clean" consumptive is commonly said to be a "safe" one, and this is measurably true, as sanatorium experience has shown; but man is fallible, and with the best intentions and care a slip may occur in some way or other. Therefore, in a family where there are children, if there is a case of tuberculosis, the safest plan is to remove the consumptive to a sanatorium or elsewhere.

Tuberculosis in the Workshop

In the workshop or factory, or wherever many persons are brought together in close contact, it occasionally happens that there is present a case of active tuberculosis, and yet the individual is able or feels compelled to work. This, however, happens less frequently at the present time on account of the medical supervision and welfare work now carried on in many of the large industrial establishments, and the provision made for the consumptive workman when he is discovered. When it does occur, the consumptive workman should be instructed in the ordinary precautions to be taken in coughing and expectorating.

The Prevention of Active Tuberculosis from a Latent Infection

As almost every one has some tuberculous infection, the problem is to prevent this inactive infection from becoming active, and the sum and substance of doing this is the avoidance of a continued exposure to the tubercle bacillus from an uncleanly consumptive; for it must always be remembered that the immediate environment of a careless consumptive is the most common and greatest source of danger, and, secondly, being well and without symptoms, to keep so, by healthful living and working under healthful conditions. Regularity in one's habits, temperance, the avoidance of excesses, proper and regular meals, sufficient rest, exercise in the open, open-air sleeping, good ventilation in

workshop, office and the home, the avoidance of over-fatigue, are the means every one should employ to live happily, healthfully, and to avoid active tuberculosis.

Dusty Occupations

As is well known, the mortality from pulmonary tuberculosis is high in the dusty trades, such as steel grinding, the use of emery wheels, stone cutting, pottery, cotton, tobacco and shoe manufacture. To prevent the inhalation of the irritating dust, appliances should be provided for the removal of the dust, such as hoods connected with fans or respirators should be worn. The laws of many states now require some provision for removing the dust in the various grinding processes, and thus shielding the workman from the injurious influence of the metallic or mineral particles.

Disinfection

When a room or apartment has been occupied by a consumptive, it is the physician's duty to see that it has been thoroughly cleaned and renovated before occupancy again. Fumigation does some good, but a thorough cleaning and renovating of paper and paint, and exposure to sunlight and daylight is far more effective. Everything that has been used by the patient should be subjected to steam disinfection or destroyed.

**The Physician's Duty in the Prevention of
Tuberculosis**

The physician from his intimate relation with so many households has an exceptional opportunity, and hence a definite obligation to disseminate knowledge with regard to the prevention of tuberculosis in the community where he practices his profession. He can impress upon the consumptive who is under his care the vital importance of preventing the spread of his disease to those about him through a proper and safe disposal of the sputum. He can seek by every means in his power to make an early diagnosis and institute timely treatment. He can see that the public of his particular community is informed of the causes of the disease, and the part each person can do in protecting himself and others from the infection; and that it understands the way in which infection takes place and how it may "become inoperative and powerless for harm." To do this is both the privilege and obligation of the physician, for at the present day the conscientious physician must regard the prevention of disease as one of his sacred duties.

CHAPTER XIII

AFTERCARE AND MARRIAGE

"Keep what you have."

Plautus.

"Oh yet we trust that somehow good
Will be the final goal of ill,
To pangs of nature, sins of will,
Defects of doubt and taints of blood."

In Memoriam. Tennyson.

Aftercare

It is now generally conceded that sanatorium treatment, and, indeed, the open-air treatment anywhere for a limited period, does little more in the majority of cases than train the patient in the open-air régime and start him on the road to recovery. After that he must himself make the journey back to assured health if he is to arrive there. If he deviates from the known way, relapse is likely to follow, which experience has shown has been only too frequent. The patient may be so far toward a permanent arrest that he can resume a part or the whole of his former occupation, or undertake some kind of work; but he should do this only under the advice of his physician under whose observation he should remain, and by whom he should be periodically examined.

Generally, from the force of circumstances, the "improved" or "arrested" case will have to return to his former occupation, which is probably the best plan, unless the occupation and the environment are manifestly unhealthy; for the mental and physical strain in a familiar occupation is far less than in learning a new one, and the income greater.

From his experience during treatment, the patient will have recognized the extreme importance of hygienic living and fresh air; and, therefore, he will seek to embrace every opportunity for obtaining fresh air day and night, and continue to model his life upon the plan pursued while taking the cure. The following letter of a former patient, quoted by Dr. Bardswell,¹ well indicates the kind of life a cured consumptive should follow. He says: "With regard to aftercare, I only carry on treatment in so far as the discipline and training of the sanatorium has made it second nature with me to observe certain laws. For instance, I make myself eat enough. In the old days I ate when I wished, and not much at that. I never fail to look out for fresh clean air. I sleep in a breeze winter and summer. I look on a draught as an angel from heaven. I choose open-air recreations rather than the theater, etc., and always keep myself busy. By so doing I have no time to think of tuberculosis, but at the same time I never forget that I may still have got the damned thing in me."

If the disease is only in the process of arrest and

¹ "The Practitioner," January, 1913, London.

yet the general condition is satisfactory, the patient can, not infrequently, do part of a day's work, and be out-of-doors the rest of the day. For example, I have a patient in this condition who spends his forenoons at his business and plays golf in the afternoons, and thus successfully follows the "cure" and at the same time continues his business. All excesses should be avoided, whether mental or physical; the weight, appetite and strength watched, and every retrogression from the normal standard of health must be immediately investigated. A bronchitis, influenza, or any respiratory disease should receive immediate and careful attention.

The cardinal rules of living which the cured consumptive must ever bear in mind are rest, sufficient and regular nourishment, fresh air and the avoidance of excesses and over-exertion. Furthermore, both the physician and patient must not forget Osler's aphorism that "Benefit is usually a matter of months, complete arrest a matter of years."

Marriage and Tuberculosis

This is a question upon which the physician is not infrequently called to give his opinion, although it is not always followed, the patient deciding the matter from his own inclination without much regard for the future.

In the first place, should a woman who has obtained an arrest of the disease marry and bear children? In answering this question, one should consider it from the standpoint of danger to the

woman, and also that of the offspring. Will the latter be predisposed to tuberculosis? If the arrest of the disease has been maintained for two years or more and the general health is satisfactory, and the conditions of life when married will not entail serious demands upon the strength, marriage can be allowed and probably there will be no recurrence of the disease. There should, however, be a sufficiently long interval between the child-bearing periods to permit the mother to fully recover her strength. As to the child, there is no reason why it should not be strong and healthy if carefully reared.

If the prospective husband is an arrested case and the woman is healthy, there is no reason why they should not marry, or why the children should not be healthy. If, however, the husband will be obliged to support his family by his own efforts, it is possible that the burden may be too heavy and cause a recurrence of the disease.

If the disease on the side of the man is not arrested but quiescent, and the general condition is good, while the woman is well, even then marriage may be acquiesced in, if the woman knows the facts and is willing to take the chances of infection, and the man the extra burdens of married life; and, again, the offspring may be healthy and remain so if protected from the source of infection.

When a husband is actively tuberculous but the disease is not far advanced and the wife is strong and healthy, it seems to me that it is a question

for them alone to decide whether they should have children, and as in the former case, the child may be healthy and remain so if removed from the father and placed under good hygienic conditions.

As a general proposition, no actively tuberculous woman should marry and bear children, for the result is generally disastrous. There are cases, however, in which this has happened, and not only has a healthy child been born, but neither during the pregnancy nor after it has the disease become more acute with the mother; but these are exceptional cases. Again, the mental effect upon a young woman who is tuberculous and wants to marry but feels she cannot do so, may have a worse influence upon the disease than marriage or even pregnancy. One can also readily imagine cases where the tuberculous wife would be ready to take the grave risk of pregnancy for the sake of an offspring. If a woman after her marriage should be found to be tuberculous, she should be advised to avoid conception.

Pregnancy and Tuberculosis

When an actively tuberculous woman becomes pregnant, there have been varying opinions given as to what should be done; and different procedures have been advised for different stages of the pregnancy and different stages of the disease. No interference with pregnancy should be undertaken without the clearest indication that the condition of the wife will be benefited thereby, and the decision

of the physician must be based solely upon the probable effect upon the wife. The interruption of pregnancy to prevent the birth of a predisposed child is never justified. It is also to be remembered that the interruption of a pregnancy is a great shock to the system and may be far more injurious than to allow the pregnancy to be completed, and unless there is a fair prospect that the life of the mother can be saved or considerably prolonged, an induced abortion should not be done.

Although it is true that pregnancy in an actively tuberculous woman has generally been followed, after the birth of the child, by an exacerbation of the disease, such is not always the case, for occasionally pregnancy has produced marked and lasting improvement. On the other hand, the artificial termination of the pregnancy has been followed by an increased activity of the disease.

The confinement of the tuberculous woman should be quickly terminated under anæsthesia, and, of course, lactation should be avoided. Every effort should be made to support and strengthen the mother during the puerperium.

From what has been said, it will be seen that the existence of pregnancy in a tuberculous wife is not always or of necessity prejudicial to the course of the disease; nor is the fact that the pregnant woman is tuberculous a justification in itself for the termination of the pregnancy. Each case should receive the most careful individual consideration, and only when one is convinced that the case is doomed if

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the pregnancy goes on, should it be interrupted. Advise as we will with regard to the marriage of a tuberculous woman, if our advice is contrary to her inclination, it will often be disregarded.

CHAPTER XIV

CASES

"Examples draw when precept fails,
And sermons are less read than tales."

Prior.

I. G. B. Male, ætat 45. Accountant.

Mother died of tuberculosis at the age of 57. Generally well. Upon three different occasions within the last four months he raised a small amount of blood. He now has some cough with expectoration in the morning. No loss of weight or strength and no dyspnœa. Good appetite. His voice is somewhat husky. He is a healthy looking man weighing 155¼ lbs.

Physical examination: T. 99.8°. P. 74. R. 24.

Questionable dullness at both apices and possibly some roughening of respiration. Examination of sputum, positive.

In this case a diagnosis could not have been made from the slight and doubtful physical signs, but the hemorrhage made it practically certain even if the sputum had not been positive. The cough and expectoration added to the certainty of the diagnosis.

The prognosis is good, for the general condition is excellent and there is no constitutional disturb-

ance. The "open-air" treatment for a while with later graduated exercise will probably produce an arrest of the disease.

II. E. A. Female, ætat 21. Cook.

Father died of acute tuberculosis. Never very well up to 17 years of age; after that stronger. Her present complaint is a tired feeling and headaches. Says she feels flushed in the afternoon. At first said she had no cough, but on questioning she thought she might have a little in the morning but no expectoration. She had lost considerable weight and strength, and had some shortness of breath on exertion. The appetite was "pretty good" and she was working. Her general appearance was fair.

Physical examination: T. 100. P. 124. R. 28.

Slight dullness at the left apex with a rough inspiratory sound. Some moist rales in the left base.

The diagnosis of tuberculosis in this case depends largely upon the symptoms,—the increased temperature and pulse, the slight cough, the loss of weight and strength and dyspnoea upon exertion. The disease is evidently active and the patient needs rigorous sanatorium treatment.

The prognosis can only be determined by the response to treatment. At present a guarded prognosis should be given, for the history is poor and the symptoms are out of proportion to the slight physical signs.

III. D. F. Female, ætat 22. Shop girl.

Family history negative. Generally well. For

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the last six months she has had a "tired feeling" and been "nervous." She coughs occasionally, but has no expectoration. She has lost weight and strength, and has some dyspnœa. Amenorrhœa for four months. Appetite poor. In appearance, she is of medium height, thin and weak.

Physical examination: T. 99.5°. P. 92. R. 28.

Nothing abnormal found in the lungs.

The above well illustrates the class of cases called "suspicious" in which no definite diagnosis can be made. The loss of weight and strength, dyspnœa, and poor appetite make one strongly suspect that tuberculosis exists. Such cases should be kept under observation and treated on general "open-air" principles.

IV. I. F. Female, ætat 25.

Tuberculosis nurse. Mother died at 27 years of age from tuberculosis. Five years ago she had typhoid fever. Has been feeling particularly well. A week before the consultation she had a slight hemorrhage and subsequently streaked sputum. She says she has no cough, but some expectoration which, on examination, was negative. No loss of weight or strength, or no dyspnœa. Appetite "very good." Thinks she has been having a little afternoon temperature. Is working. She weighs 215¼ lbs. and looks well.

Physical examination: T. 100.5° P. 78. R. 18.

Questionable dullness in the left supraclavicular

space with somewhat rough respiration. Otherwise, negative.

From the slight physical signs, a diagnosis could not be made; but the hemorrhage and increased temperature make the diagnosis of active tuberculosis practically certain.

The prognosis is favorable if active treatment is at once instituted. The comparatively low pulse is a favorable omen.

V. S. G. Male, ætat 29. Salesman.

Family history negative; no known exposure to the disease; always well though never very strong. Subject to "head colds." Chief complaint is "getting tired." He has lost about five pounds in weight; no loss of strength and no dyspnoea. Slight cough and expectoration. Appetite excellent. He feels able to work. In appearance he looks well and weighs 171-¼ lbs.

Physical examination: T. 99.2°. P. 76. R. 16. Lung capacity, 250 cubic inches.

There is slight but definite dullness at the right apex and on deep inspiration a few fine persisting rales, both above and below the clavicle.

Here the definite physical signs indicate a probable slight tuberculous infiltration; but the absence of any marked symptoms shows that there is no toxæmia.

The prognosis is very good, and the patient need not necessarily be removed from his work, but kept under observation and placed under good hygienic conditions.

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VI. T. G. Male, ætat 21. Student.

Mother died of tuberculosis, and sister has been in the sanatorium with the same disease. He was at home during his mother's illness. Has always been well. Has had a "cold" with intermissions for two months. The night before consulting his physician, he had a small hemorrhage. He has a slight cough with streaked sputum. No loss of weight or strength or no dyspnea. Appetite pretty good. Is attending to his duties. His appearance is that of health, although somewhat thin.

Physical examination: T. 99°. P. 72. R. 24.

Slight and doubtful dullness at both apices, with possibly somewhat roughened respiration and prolonged expiration. Examination of sputum, positive.

Here is a case in which the first definite symptom was the hemorrhage which was the cause of consulting his physician. Without the positive sputum or the hemorrhage a definite diagnosis could not have been made.

A favorable prognosis was given and sanatorium advised. Four years and a half later he died. On account of the family history, a guarded prognosis should have been given.

VII. J. H. Male, ætat 47. Dentist.

Family history negative. No known exposure. Always fairly well. Has had more or less hoarseness and cough for some time. Twenty-five and again four years ago he had a hemorrhage. He now has a cough with expectoration, which is posi-

tive. He has lost ten pounds in weight, although his present weight is 178 lbs. His strength is fair and he does a full day's work. Some dyspnœa. The appetite is good. His appearance is that of health.

Physical examination: T. 99°. P. 76. R. 16.

Marked dullness over both fronts, with bronchovesicular respiration, especially at the right apex. The voice is ++, and there is a moderate number of rales. The same condition exists in the corresponding areas behind. There is hoarseness which is suggestive of tuberculous laryngitis. Five months later the rales had disappeared, except above the left clavicle; he had gained 11 lbs., his strength had improved; the temperature range was from 97.4° to 98°. He had been sleeping and living in an open tent in the country, going to his business every day.

The above represents a case of advanced tuberculosis of slight activity with little if any toxæmia, and where the resistance not only maintained itself but gained upon the disease, and this in spite of strenuous daily work. Although such cases rarely become permanently arrested, they remain quiescent for long periods, and the individual not only has the appearance of health, but is able to follow his occupation. When once, however, the resistance is broken by some intercurrent disease, such as an influenza or a sharp hemorrhage, for example, acute symptoms often quickly supervene and a fatal result follows.

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VIII. D. R. Male ætat 22. Leather business.

Father died of pulmonary and laryngeal tuberculosis, and he was more or less intimately associated with him. Generally well. A well developed, muscular man, with a deep, full chest. Has been working in dusty places. He has had a cough for three or four months, with some expectoration, which was negative. Once he thought he had streaked sputum. No loss of weight and strength, and no dyspnoea. Good appetite; weight, 141 lbs.

Physical examination: Slight increase of pitch with somewhat roughened and possibly diminished respiration at the left apex; otherwise, negative. Subsequently, seven months later, the examination was negative and he had gained 11½ lbs. The Roentgen examination at this time showed no evidence of "acute infiltration of lung tissue," but "very definite peribronchial thickening together with an increase in the bronchial gland shadow," "the markings of the right root and particularly of the ascending division were abnormally prominent."

In the opinion of the Roentgenologist, the plates were consistent with a diagnosis of early pulmonary tuberculosis. In this case a definite diagnosis could not be made, either from the symptoms, physical signs or X-ray findings. The weight of all the evidence, however,—the intimate association with his father, the continuing cough, the streaked sputum, the slight physical signs, and the X-ray

picture,—all pointed toward an early tuberculous infection.

The question to be decided was the future plan of life: Here was a young man well started in his business career. Should he abandon it for an out-door life, or continue in it under observation? Under all the circumstances, it was decided that the only safe course was to give up his business and in-door life in the city and live an out-door life in the country. This was accordingly done, and he went West upon a ranch.

IX. J. B. Male, ætat 28. Fireman.

Family history and exposure, negative. He complained of a dry cough for the past two weeks and soreness across the chest; chilly sensations; poor appetite.

Physical examination: T. 98.2°. Weight, 132½ lbs.

Dry rales throughout the chest with suspicious signs at the left apex.

The diagnosis then made was chronic bronchitis with a question of infiltration at the left top. Twelve days later the examination showed many constant fine moist rales throughout the upper left lobe, and the X-ray plate verified the suspicion of infiltration at the left apex.

This case shows how a general bronchitis may conceal an underlying tuberculous lesion, and emphasizes the importance of repeated examinations and continued observation of all cases of bronchitis.

X. J. C. Male, ætat 39. Inside work as stockkeeper.

He is one of eleven children, of whom four have died of tuberculosis. He has always been well, although he is now about sixteen pounds under weight. His chief complaint is soreness in various joints, weakness, night sweats and pain in the left side, which, he says, "catches his wind."

Physical examination: T. 101°. P. 115.

Dullness in the left scapular region. Two days later, there was marked dullness, or flatness, over the lower left lobe with distant bronchial respiration, and at the apex of the same lung, slight dullness with broncho-vesicular respiration and a few moist rales. The diagnosis was made of pleurisy with effusion, and incipient tuberculosis. The case was reported and sanatorium treatment advised.

This case illustrates the importance of a careful examination of the apex of the lung when there is an effusion in the lower half. The family history would also make one suspicious of tuberculosis.

XI. J. T. Male, ætat 31. Machinist.

A healthy looking, well nourished man, weighing 185 lbs. Family history and exposure to infection, negative. Eight months ago some one suggested to him that he might have tuberculosis, and he presented himself for examination at a tuberculosis dispensary. From the result of the examination, he was sent to a sanatorium. Three months later he was examined at another dispensary and no evidence of tuberculosis was discovered. He

now says that he has a slight cough in the morning with a little expectoration, and thinks he has lost some strength; no dyspnœa; appetite good. While at the sanatorium he was put to work.

Physical examination: T. 98.6°. P. 88. R. 24.

Sputum negative. Examination of the lungs negative.

Here is a case in which there was either a slight infection, which was promptly arrested under sanatorium treatment, or in which there was a mistaken diagnosis. In such doubtful cases, either one of two courses may be followed: the patient may be kept under observation, or, if the symptoms and physical signs are suspicious and all pointing in one direction, active treatment may be instituted; the latter is the safer course.

XII. S. T. Female, ætat 24. Married. Frail in appearance.

Her husband has pulmonary and laryngeal tuberculosis. Has had a cough for four or five months, with expectoration which was negative. She has lost weight and strength and has some dyspnœa. She says she has twice had some hemoptysis, but the record does not state how much. Appetite poor. Two months ago she was examined at a dispensary and told she had no tuberculosis.

Physical examination: T. 98.6°. P. 88. R. 32.

Nothing found in the lungs.

The diagnosis of tuberculosis was made, founded

wholly upon the symptoms and the exposure to infection through association with her husband. It is possible, of course, that the diagnosis was wrong, but with such an array of symptoms, viz., loss of weight and strength, shortness of breath, poor appetite, and a history of hemoptysis, together with the exposure to infection, the diagnosis seems fully justified. She was advised to take active "open-air" treatment.

XIII. F. S. Male, ætat 19. Electrical engineer.

A healthy appearing, well nourished young man weighing 162 lbs.

Family history negative; exposure, been associated in his work with a man who had a cough with expectoration. Generally well, athletic. Within the last week he has had hemoptysis on three different occasions, a cupful in all, he thinks. He has a slight tickling in his throat and slight expectoration of mucus; no other symptoms.

Physical examination: T. 100°. P. 64. R. 14.

Lungs negative; expansion, 6 c.m.

The diagnosis of tuberculosis was made and sanatorium treatment advised; but he felt so well he did not think it was necessary to give up his work.

The diagnosis in this case was made almost solely upon the fact of the hemoptysis, there being no constitutional symptoms and no physical signs. The increased temperature was probably only temporary from the result of the hemorrhage. The ex-

posure to infection also strengthened the diagnosis.

XIV. J. K. Female, ætat 22. Housewife.

Of medium height and rather thin; weighs 126 lbs.

Family history negative. Exposure: a "chum" of hers, she says, with whom she has constant association, has tuberculosis. Always well. Is now four months pregnant. Four months ago she was in the hospital for ten days with acute bronchitis, she says. For the past three months she has had pain in the chest. Three weeks ago she was examined at a tuberculosis dispensary and was told she must go to a sanatorium. She has no cough, but sometimes a little expectoration, which was negative. There is loss of flesh and strength, and dyspnœa. The appetite is not very good.

Physical examination: T. 99.8°. P. 96. R. 24.

At the left base from below the angle of the scapula, there were fine and medium moist rales in abundance. Otherwise, the lungs were negative. Day camp or sanatorium advised.

This case is of interest for two reasons: First, is the condition at the left base a tuberculous one? "Abnormal physical signs at the base," says Brown, "should be looked on as nontuberculous until definitely proved so." Considering the exposure to tuberculosis and the symptoms, one is inclined to consider this a case of tuberculosis until proved the contrary. Second, especial attention should be given to all symptoms pointing to tuberculosis in a pregnant woman. When in doubt, active treat-

ment should be established so that the woman may be in the best possible condition at the birth of her child, for experience has shown that after confinement any existing tuberculous lesion is likely to become more active.

XV. D. H. Male, ætat 26. Bookkeeper.

Family history: brother died of tuberculosis, and he was living with him at the time. Never has been ill since a child. Two years ago had a hemorrhage of a moderate amount, and a repetition of the same two months ago. Says he has had no other symptoms except a cold for about a week. Has a slight tickling cough with a very little expectoration. No loss of weight or strength and no dyspnoea. Appetite very good. Is able to work.

Physical examination: T. 99.2°. P. 96. R. 16.

Sputum, positive. Marked dullness over both fronts down to about the fourth rib. Respiration very rough. Voice +. A few rales at both apices. On the back in the corresponding area the same signs are found but the rales are more numerous, extending down to the middle of the scapula.

Diagnosis: advanced pulmonary tuberculosis. The striking characteristic of the case is the extent of the pulmonary lesion in comparison with the almost complete absence of constitutional symptoms. The man does not feel ill and is able to work. It is very doubtful if so extensive disease can ever be arrested, and so long as the equilibrium is maintained between the resistance and the disease,

the man is comparatively safe and may live indefinitely.

As to treatment, it is probably the wisest course to attempt an arrest by the open-air cure. On the other hand, he may do as well to continue his occupation under good hygienic conditions of work and living, watching carefully for any break in the resistance.

XVI. O. P. Male, *ætat* 42. Dealer in furs.

Family history and exposure to infection, negative so far as known. Has worked hard since sixteen years of age and always been well. Six months ago he had a fracture of the ankle and has not felt well since. Three months ago he began to lose weight and strength, and had a cough and chills, and thinks he had some fever. He consulted a laryngologist who, from the appearance of the larynx, referred him for examination of the lungs. At that time there was a degree rise of temperature in the afternoon, a pulse of 84 and weight of 146 pounds. He had a troublesome cough with a small amount of expectoration which was positive. He had no appetite and had dyspnoea on exertion. He was taking some exercise and attending to business.

Physical examination: Marked dullness at both apices with broncho-vesicular respiration, voice + and a few fine, moist rales on deep inspiration.

Diagnosis: Moderately advanced, active tuberculosis.

Treatment: He was put at rest in a well-venti-

lated room in his cottage by the sea-shore. At the end of two months the temperature was normal and there was but slight cough and expectoration. The weight was increasing, and there was general improvement in the constitutional condition. Two months later there were but a few sticky rales upon the physical examination. A year after the first examination, he had practically no cough, no tubercle bacilli in the sputum, and said he had not felt so well for years; weight, 156 lbs. Meantime he had made a trip to Europe. The physical examination was that of an arrested case. He has been perfectly well for the last six and a half years and all the time has been attending to his business.

This case illustrates the quick response of the resistance to the infection under only a moderate degree of the rest and open-air treatment, and the permanence of the cure. Not every case will respond so rapidly and so perfectly.

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